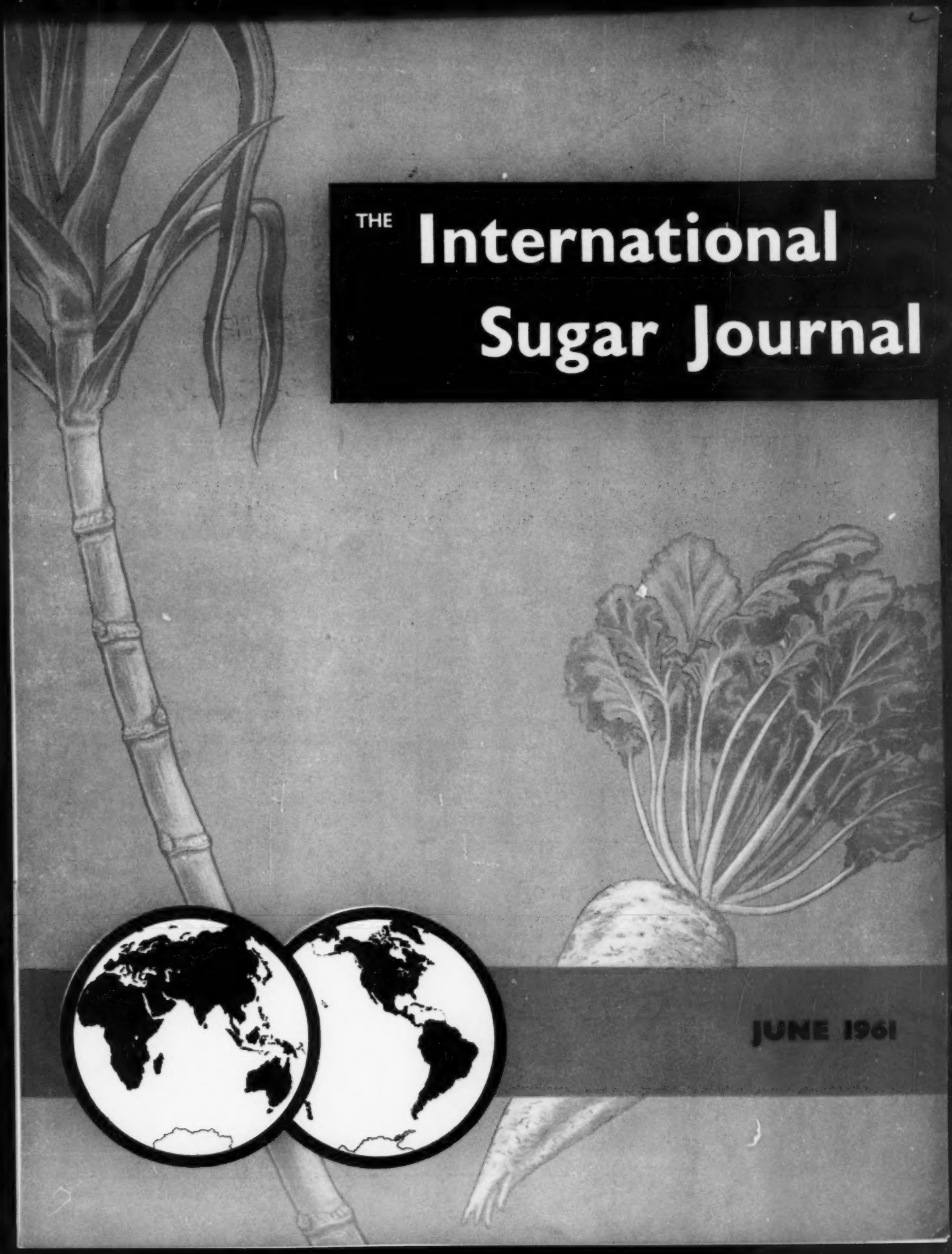

THE International Sugar Journal
JUNE 1961

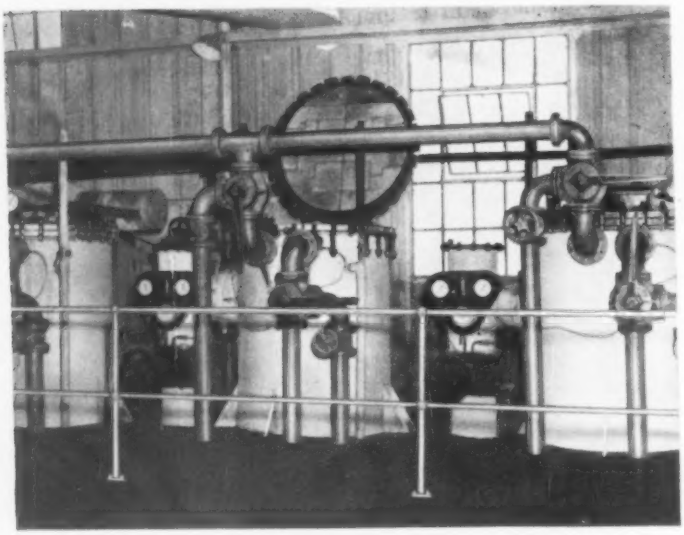
BLAIRS

COMPLETE

# SUGAR

## FACTORIES & REFINERIES

## DISTILLERIES, ABSOLUTE ALCOHOL & CHEMICAL PLANTS



Our illustration shows three High Velocity Mild Steel Vertical Juice Heaters, 3'-6" diameter x 13'-0" long, each having a heating surface of 1,000 square feet.

*Sole Makers of*
*MULTIPLEX FILM*
*EVAPORATORS.*

# BLAIRS LIMITED

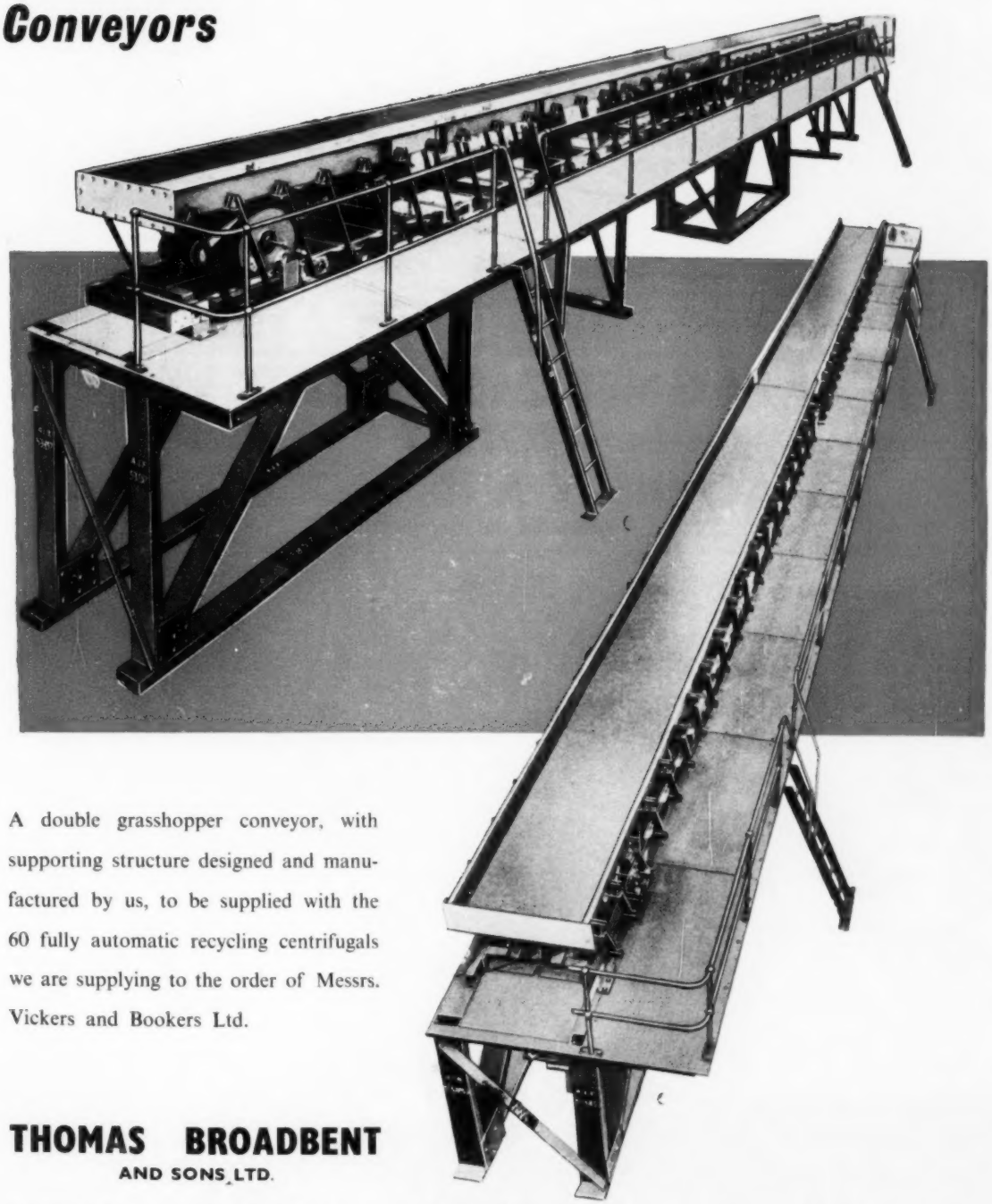
WOODVILLE STREET · GLASGOW S.W.1

Cables — "BLAZON GLASGOW"

LONDON OFFICE — 38 GROSVENOR GARDENS, S.W.1 · Cables — "MULTIVAP SOWEST LONDON"

# BROADBENT

## *Grasshopper Conveyors*

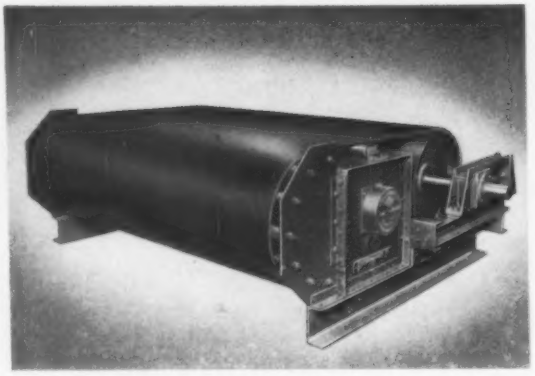


A double grasshopper conveyor, with supporting structure designed and manufactured by us, to be supplied with the 60 fully automatic recycling centrifugals we are supplying to the order of Messrs. Vickers and Bookers Ltd.

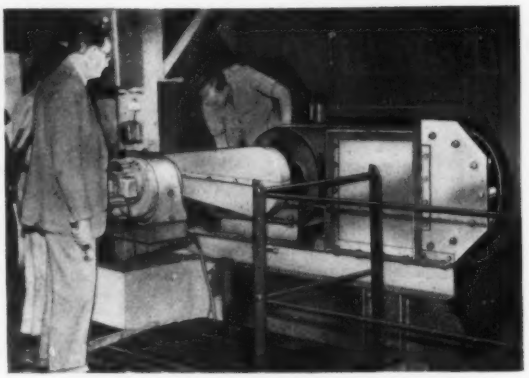
**THOMAS BROADBENT**
AND SONS LTD.

CENTRAL IRONWORKS · HUDDERSFIELD · ENGLAND

# MAGNETIC CONVEYOR HEAD



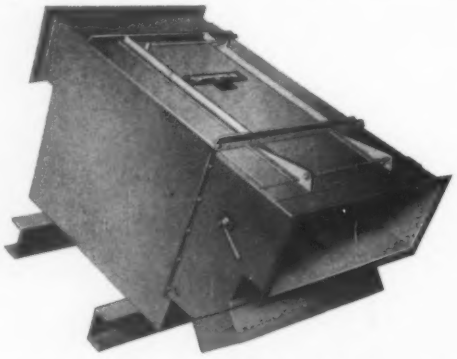
Boxmag patent MH. 2484. Conveyor Head built into an 84" wide short belt conveyor, photographed prior to despatch. The machine is designed for installation, as shown on the adjacent illustration.



Boxmag patent MH. 2484 installed in the chute between a sugar cane carrier and crusher, at a factory in Mauritius. It is designed to remove tramp metal automatically and continuously without an operator's attention. (write for leaflet 62/2).

# MAGNETIC SEPARATORS PROTECT MACHINERY AND PRODUCTS

( Write for further details )



Boxmag Superflux Magnetic Chute for removal of ferrous contamination from refined sugar to decontaminate the product.

A Boxmag Unimajor block type Permanent Magnet. One of the many types of separators suitable for general applications in sugar factories. (write for details of full range).

BOXMAG

Telephone
Central 5391

Telegrams :
Boxmag Birmingham

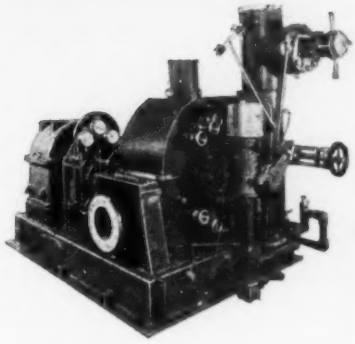
## ELECTROMAGNETS LTD

BOXMAG WORKS • BOND ST. • HOCKLEY • BIRMINGHAM 19 • ENGLAND

# Mirrlees' STEAM TURBINES for the Sugar Factory

**MIRRLEES STEAM TURBINES COVER A WIDE RANGE OF APPLICATIONS IN THE SUGAR FACTORY FROM**

**CANE KNIVES DRIVE**

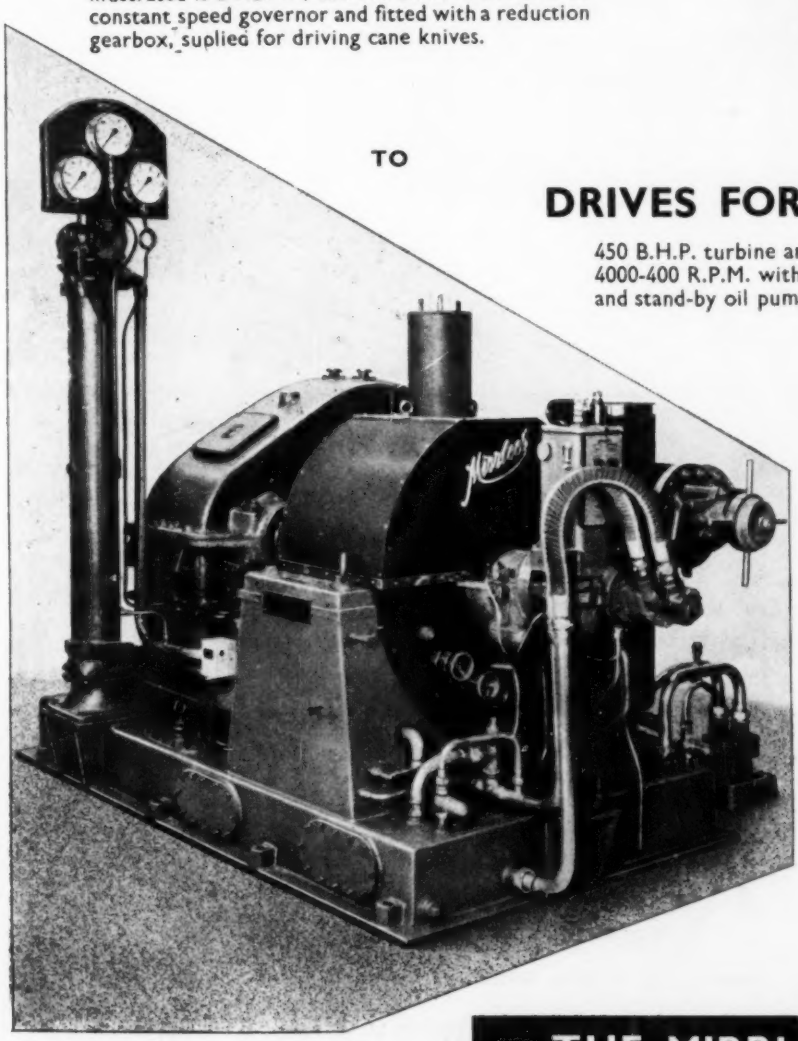


Illustrated is a F.E.A.7, 350-400 B.H.P. turbine with constant speed governor and fitted with a reduction gearbox, suplied for driving cane knives.

**TO**

**DRIVES FOR SUGAR MILLS**

450 B.H.P. turbine and single reduction gear box 4000-400 R.P.M. with variable speed governor and stand-by oil pump.



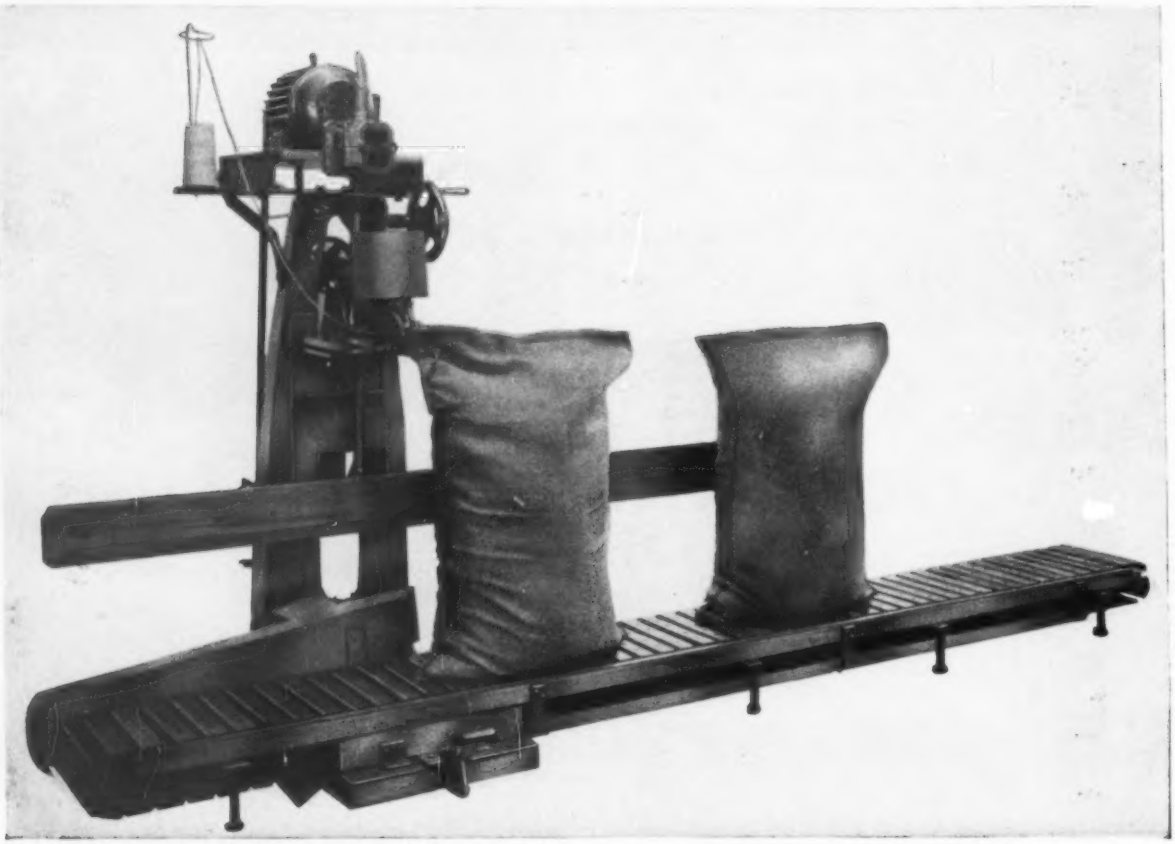

**MAY ALSO BE USED AS A LOW COST REPLACEMENT FOR EXISTING PRIME MOVERS WHERE INCREASED MILLING CAPACITY IS REQUIRED**

**THE MIRRLEES WATSON COMPANY LIMITED**
**GLASGOW SCOTLAND**

# The 'Super' Universal Sack Closing Machine

**MODEL NO. 5B**

*Fitted with 10 or 12 ft. Conveyor and Special Clutch Drive*



*This machine is fitted with a conveyor 10 or 12 ft. overall and a Special Clutch Drive which allows the conveyor to be run independently of the sewing head.*

*Jute, Hessian, Paper Lined Hessian, Cotton and Paper Sacks weighing from 50 to 325 lbs. can be sewn on this machine.*

*Machines can be seen working by appointment.*

*Power required 2 h.p.* *Shipping weight : 14 cwts.*

---

**Manufactured in Great Britain by :**

## The Sack Filling & Sewing Machine Syndicate Limited

**(Timewell's Patent)**

**TIMEWELL WORKS · LOCKFIELD AVENUE · BRIMSDOWN · ENFIELD . MIDDX.**

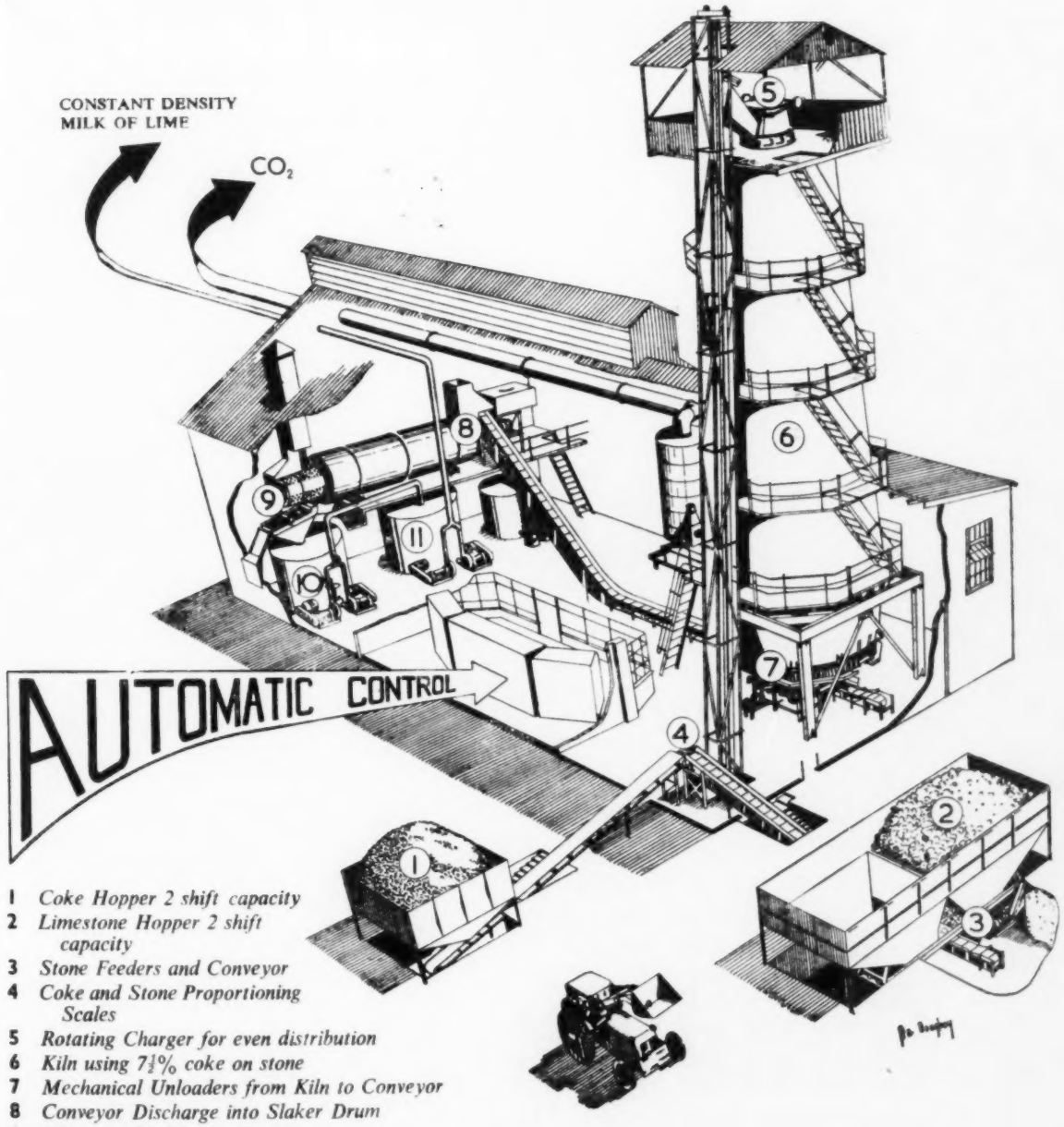
*Telephone :* HOWARD 1188 *Telegrams :* FECIT, ENFIELD

CONSTANT DENSITY

# MILK OF LIME PRODUCTION

## USING ONLY ONE OPERATOR PER SHIFT

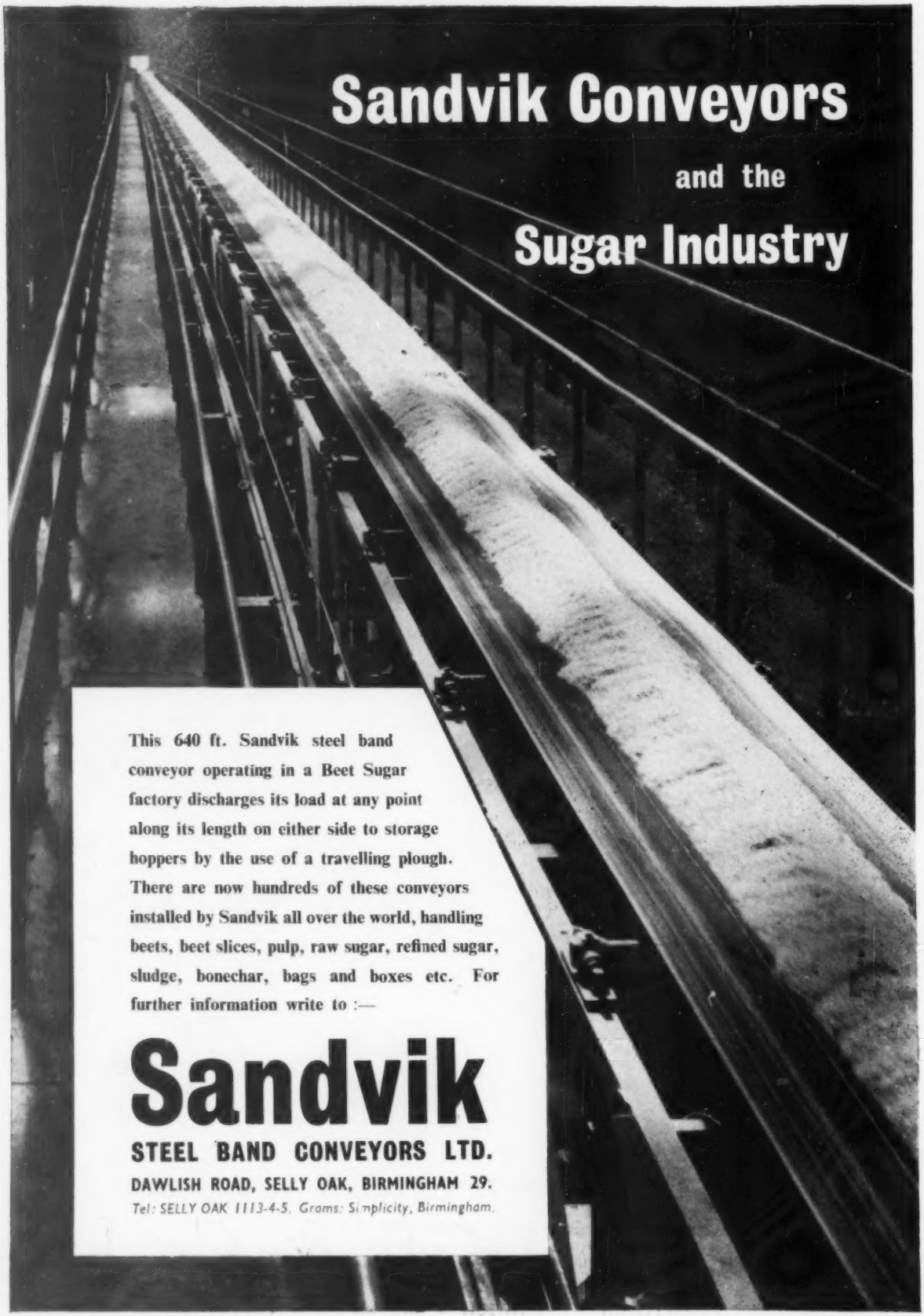
AS SUPPLIED TO THE BRITISH SUGAR CORPORATION




1 *Coke Hopper 2 shift capacity*
2 *Limestone Hopper 2 shift capacity*
3 *Stone Feeders and Conveyor*
4 *Coke and Stone Proportioning Scales*
5 *Rotating Charger for even distribution*
6 *Kiln using 7½% coke on stone*
7 *Mechanical Unloaders from Kiln to Conveyor*
8 *Conveyor Discharge into Slaker Drum*
9 *Rotary and Vibrating Screens*
10 & 11 *Milk of Lime Density Correction and Storage Tanks*

# COCKSEDGE & Co LTD

*Telephone: Ipswich 56161 (5 lines)* **IPSWICH . ENGLAND** *Telegrams: Cables:* } *Cocksedge, Ipswich*




This 640 ft. Sandvik steel band conveyor operating in a Beet Sugar factory discharges its load at any point along its length on either side to storage hoppers by the use of a travelling plough. There are now hundreds of these conveyors installed by Sandvik all over the world, handling beets, beet slices, pulp, raw sugar, refined sugar, sludge, bonechar, bags and boxes etc. For further information write to :—

# Sandvik

**STEEL BAND CONVEYORS LTD.**

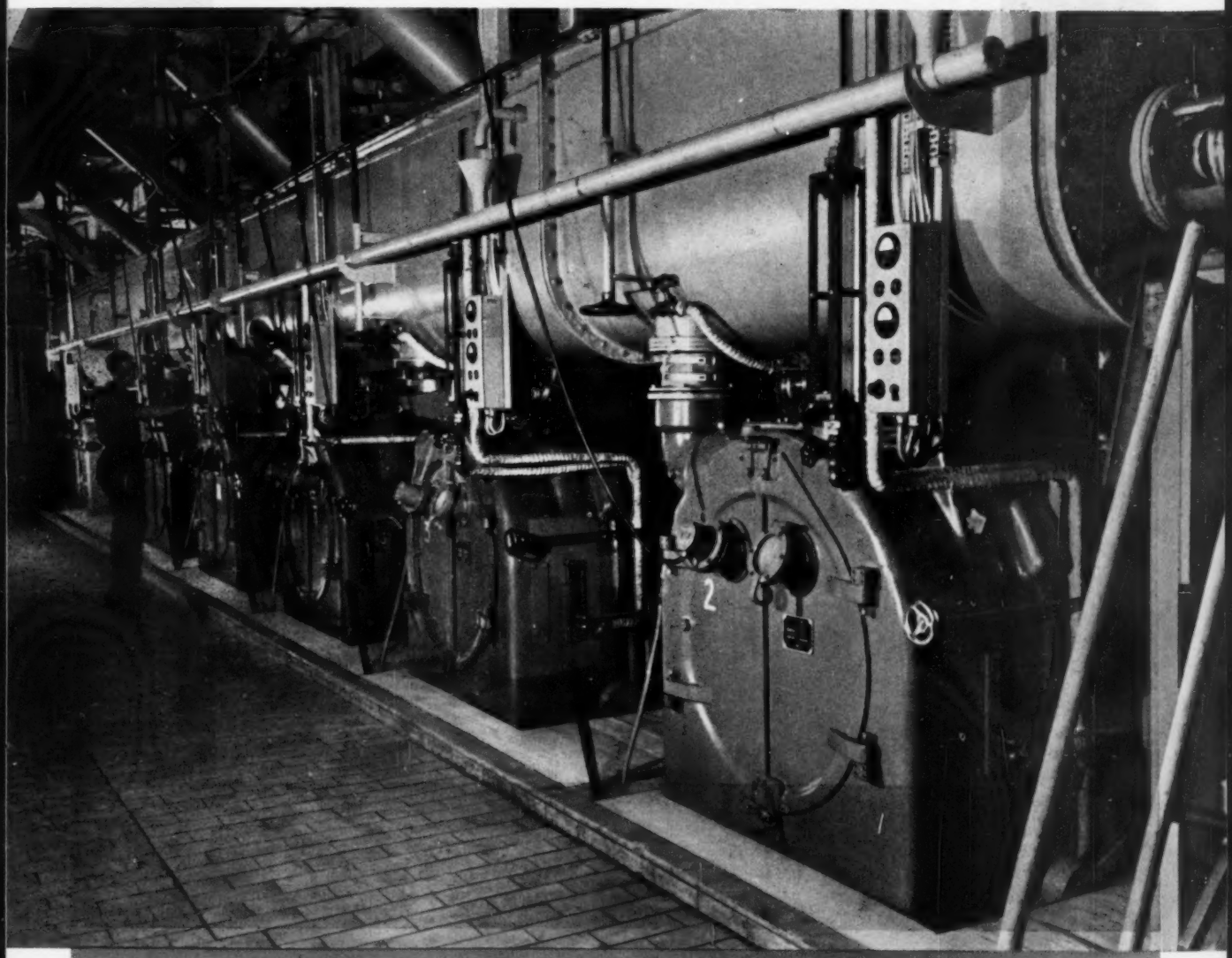
**DAWLISH ROAD, SELLY OAK, BIRMINGHAM 29.**

*Tel: SELLY OAK 1113-4-5. Grams: Simplicity, Birmingham.*

# ESCHER WYSS

## continuous centrifuges for the sugar industry

A battery of six push-type centrifuges, Model C 4 for medium-product sugar and affinated low-grade sugar, installed at Groningen Sugar Factory/Holland

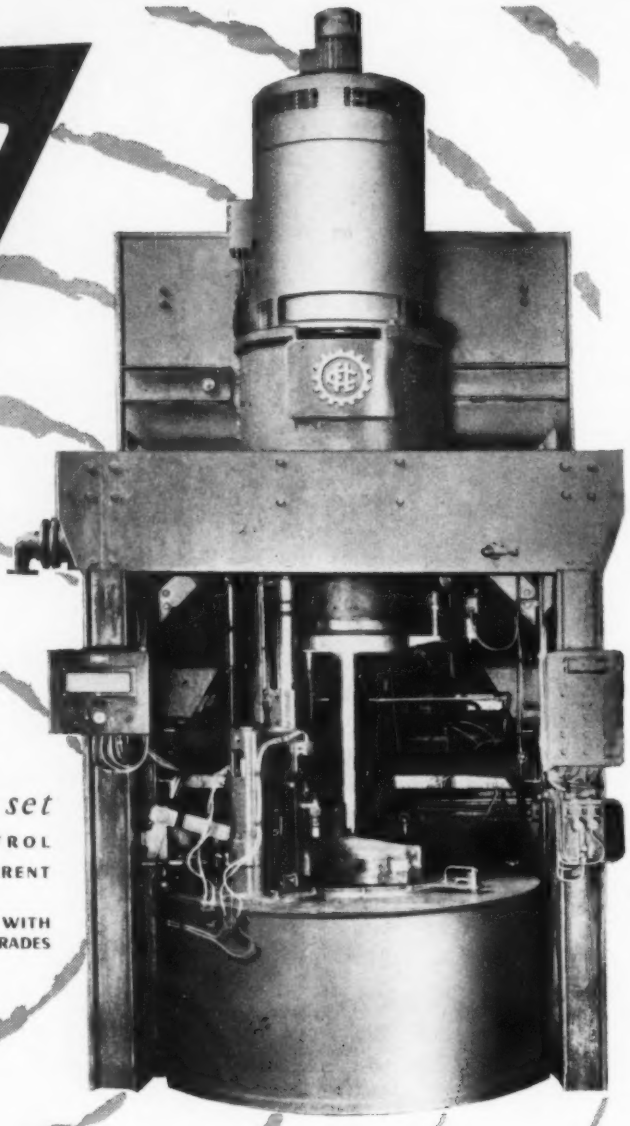


**Escher Wyss Ltd., Zurich/Switzerland**
London Office: Escher Wyss Ltd.,
Terminal House, Grosvenor Gdns., London, S.W.1, Phone Sloane 8101

# Fully automatic!

the new

# CENTRIFUGAL



*driven by*

**WARD-LEONARD** *set*

- ELECTRONIC CONTROL
- ELIMINATION OF CURRENT PEAKS
- RECORD PRODUCTION WITH MASSECUITES OF ALL GRADES

*Battery of 4 centrifugals at the Fontaine-le-Dun Sugar Factory (France)*

S.A.G. - PARIS

# FIVES LILLE - CAIL

**7, rue Montalivet, PARIS (8e) - Tél.: ANJou 22-01 et 32-40**

# Save 7 Ways on Sugar Production Costs WITH THE GRUENDLER CANE SHREDDER PROCESS

1. *It increases sucrose extraction*
2. ***It increases capacity considerably***
3. *It reduces mill strain*
4. ***It lowers steam requirements***
5. *It results in better burning bagasse*
6. ***It gives mill tramp iron protection***

AND 7

## IT ALLOWS CANE TO REMAIN STANDING IN THE FIELD TO MATURE AN ADDITIONAL TWO TO FOUR WEEKS

This is an advantage not only because the delay in cutting the cane will result in more sucrose, but will also result in better yield. The Gruendler Process relieves strain on the mill tandem to such an extent that the grinding rate is greatly increased and the total grinding is accomplished in much less time, permitting additional maturing of cane

The Gruendler Cane Shredder Process will pay for itself in 1-1½ crops.

CUT OUT AND MAIL THIS COUPON TODAY!

**Gruendler**

**CRUSHER & PULVERIZER CO.**

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2530 Terrace Ave.,
Baton Rouge, La., U.S.A.

Mr. Leo Freeman, Vice-President — 2530 Terrace Avenue
Gruendler Crusher & Pulverizer Co. — Baton Rouge, La., U.S.A.

Please send free (gratis) portfolio of information about the Gruendler Cane Shredder Process to:

MY NAME

NAME OF MILL

ADDRESS

COUNTRY

# Farrel rubber-belt carriers

*proven cleaner, more durable in installations since 1952*

54 installations since 1952 have proven Farrel rubber-belt intermediate carriers definitely superior to the conventional chain and slat type. Reports from users indicate that maintenance of these simple units is almost unheard of, operation is cleaner and retention of bagasse and imbibition better.

The first of these carriers, for example, was installed at Central Plata, Puerto Rico, in 1952. It was used for 6 crops in grinding 2½ million tons of cane. According to chief engineer Rafael Labiosa, "Not a single minute has been lost due to mechanical failure of the rubber belt and the rest of the components of its units." The belt, which is still in usable condition, is now carried as a spare.

The performance of the belt is all the more amazing when you consider that it had only 1/16" rubber covering on the carrying side. Subsequent units supplied by Farrel have a 1/8" rubber coating.

Farrel's patented carrier has been designed for easy replacement of a slat carrier during a short shut-down. The endless rubber belt has rubber cleats on the top every six inches for better mill feed.

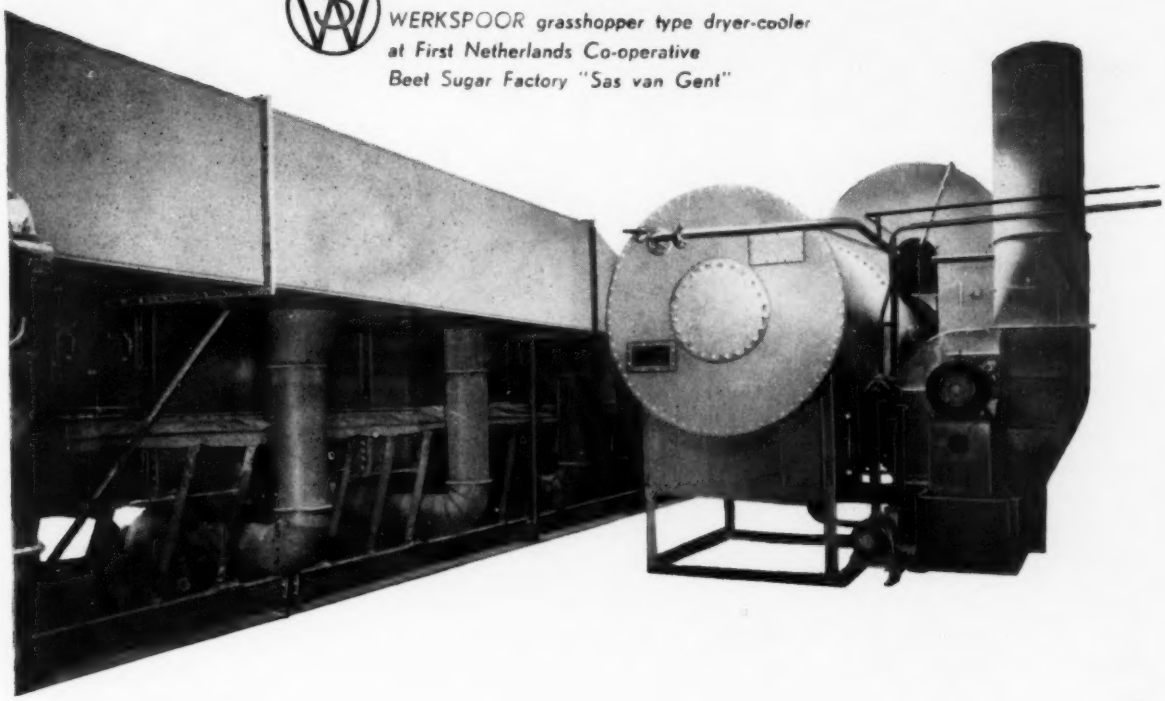
Send for a quotation covering your requirements.

**FARREL-BIRMINGHAM COMPANY, INC.**
**ANSONIA, CONNECTICUT, U. S. A.**
*Plants:* Ansonia and Derby, Conn., Buffalo and Rochester, N. Y.

FB-1202

One of the Farrel rubber-belt carriers in operation at Central Plata, Puerto Rico.

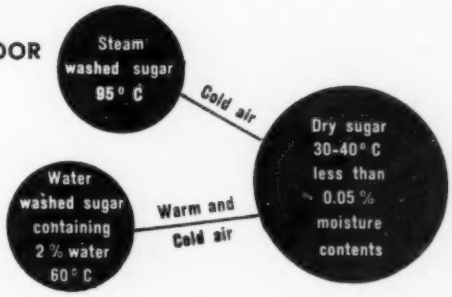
FARREL®



*WERKSPOOR grasshopper type dryer-cooler at First Netherlands Co-operative Beet Sugar Factory "Sas van Gent"*

# *This new* WERKSPOOR *grasshopper type dryer-cooler* keeps the lustre of your sugar

**with its simple and low construction, economical working, built in any capacity you may require, this modern WERKSPOOR apparatus will guarantee you:**


Steam washed sugar 95° C
Cold air
Dry sugar 30-40° C less than 0.05 % moisture contents
Water washed sugar containing 2 % water 60° C
Warm and Cold air

- **absolutely undamaged crystals**
- **drying and cooling in record time**
- **close contact air-sugar**
- **completely dust free atmosphere**

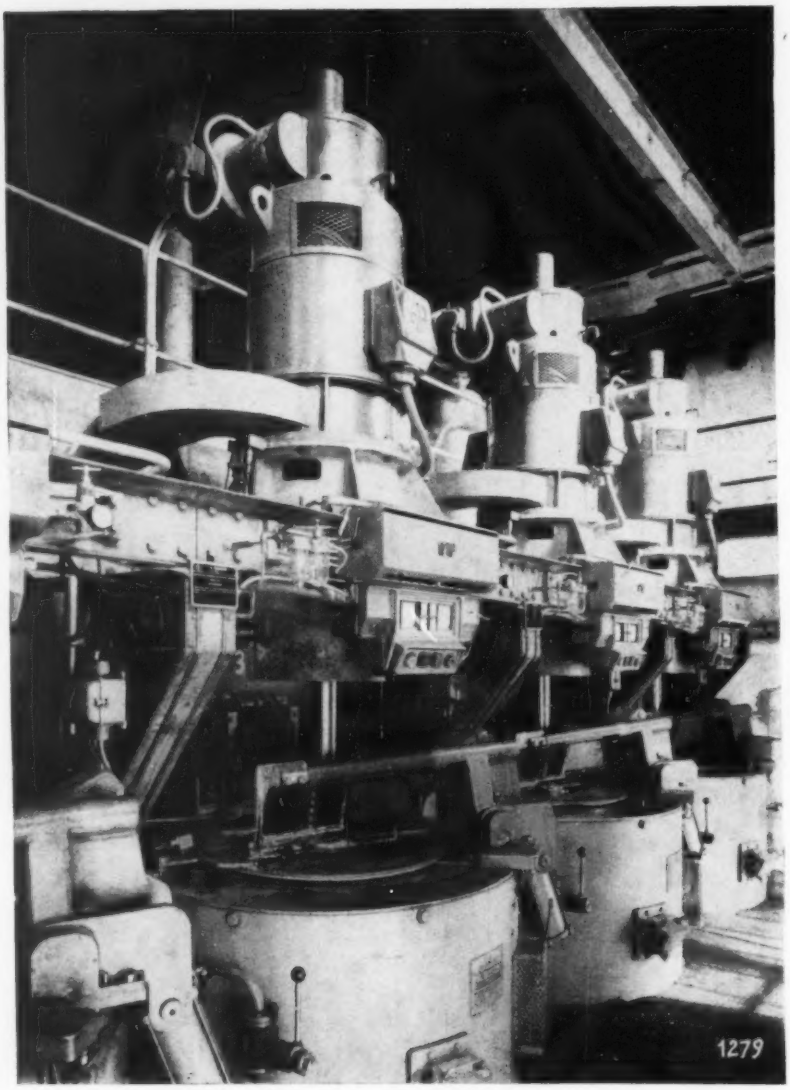
STORK — VERENIGDE MACHINEFABRIEKEN V·M·F NEDERLAND STORK • WERKSPOOR — WERKSPOOR

*For grasshopper type dryer-coolers please apply to Werkspoor, Amsterdam*

Bauduin

Since it was established in 1890, our Company has manufactured machinery for the sugar industry, and for more than forty years has specialized in constructing centrifugals.

Our Technical Service is continually developing machines which incorporate improvements designed to meet, the technological requirements of new and varying processes in the sugar industry, taking into account the demands of the European Common Market. These new centrifugals are distinguished for their high grade of *standardization* and for their low cost both from the point of view of the purchase price and running costs.




# FULLY AUTOMATIC SUGAR CENTRIFUGALS

| *Type* | *Basket D × H* | *Basket cross section* | *Massecuite Max. Charge* | *Performances* | | |
|---|---|---|---|---|---|---|
| | | | | *Mod.* | *Max. sp. r.p.m.* | *Cycles per hr.* |
| "SCARA. U" | 1250 × 830 mm. | Cylindrical with truncated cone shaped bottom | 500 kg. | Normal | 1000 | 30 |
| | | | | Velox | 1500 | 25 |
| "SCAME. P" | 1050 × 585 mm. | Cylindrical with flat bottom | 350 kg | Normal | 1500 | 20 |
| | | | | Velox | 1800 | 10 |
| "SCAME. G" | 1220 × 762 mm. | Cylindrical with flat bottom | 650 kg. | Normal | 1000 | 25 |
| | | | | Velox | 1500 | 20 |

BOSCO TERNI

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**A. BOSCO**

**TERNI** **ITALY**

# Use rugged LINK-BELT

# 900

## class chain

## *for intermediate cane carrier service*

You cut downtime to a minimum when you specify Link-Belt 900 Class chain for intermediate carrier service.

This durable chain stands up under the most gruelling and corrosive carrier conditions. The special Link-Belt rib design gives additional link strength. Double sprockets contact outboard driving lugs . . . bagasse cannot jam in centre pockets of links with this method of driving. Result: Longer trouble free operation . . . fewer conveyor shutdowns.

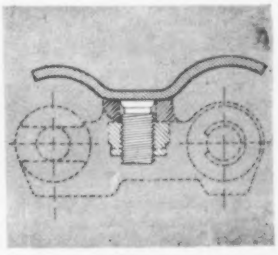
Link frames—available in malleable iron, Promal, bronze or stainless steel—can be furnished with pins and bushings of either carbon steel, bronze or stainless steel.

For complete information on Link-Belt chains and sprockets, contact your Link-Belt representative. Or write direct for Book 2640 containing full information on Link-Belt's complete line of sugar-handling equipment.

15.051-H

**COMPONENTS** are accurately made, carefully assembled. Wearing shoes at open end of link prevent tilting. Bushings are renewable, fit securely in barrel. Pins are firmly locked to prevent rotation in sidebar—cotter type assures easy assembly.

**WELDED STUD SLATS** eliminate slat hole elongation, prevent juice leakage and resist corrosion. Longer carrier life is assured because slats and chains are properly matched. Stainless steel self-locking nuts should be tightened with a torque wrench in assembly . . . disassembly is easy.



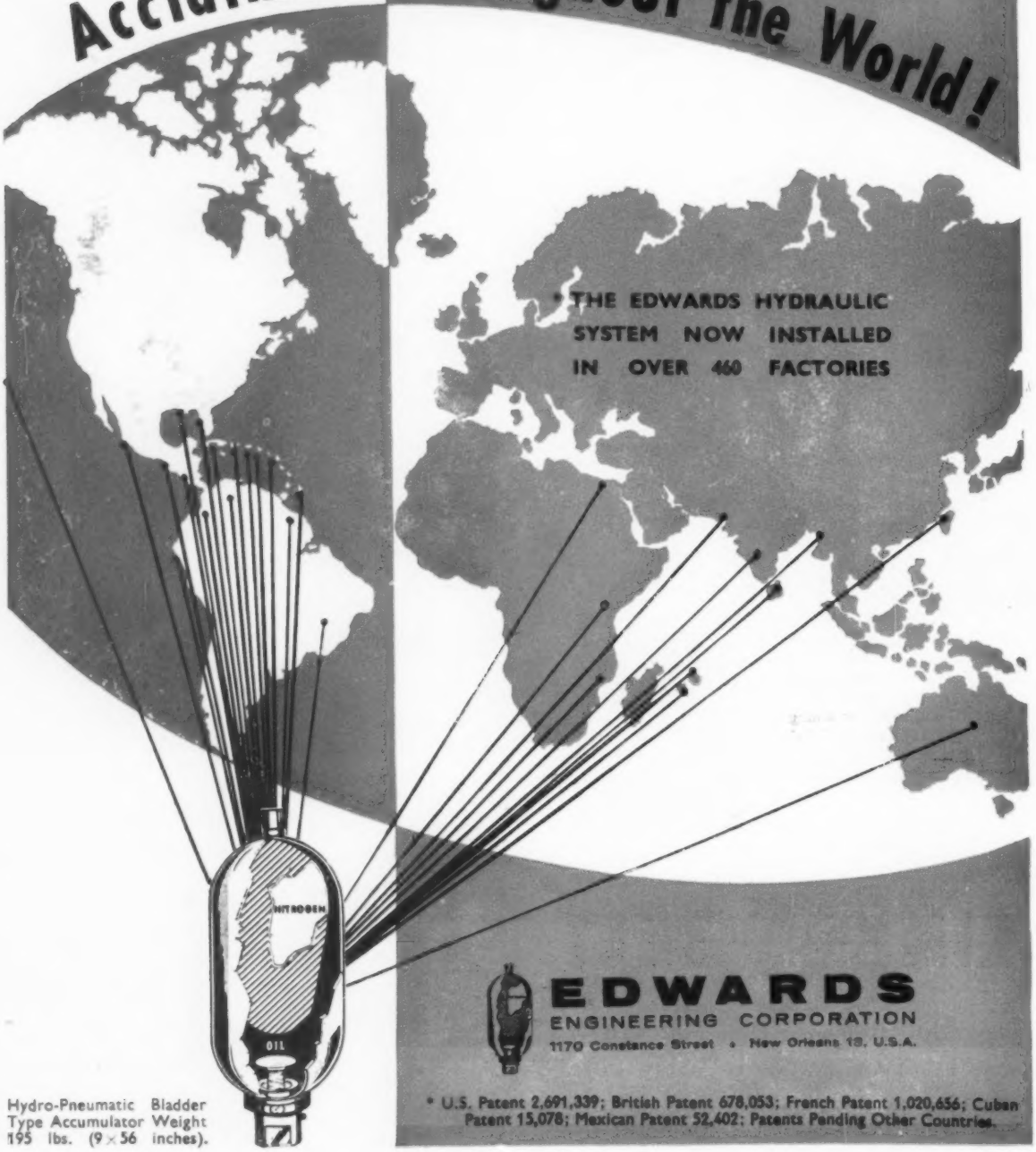
# LINK-BELT

**CHAINS • SPROCKETS • SLATS**

**LINK-BELT COMPANY**: Engineers · Manufacturers · Exporters of Machinery for Handling Materials and Transmitting Power · Established 1875. **EXPORT DIVISION**: Dept. 661-ISJ, 233 Broadway, New York 7, U.S.A., Cable Address: Linkbelt—New York · Australia, Marrickville (Sydney) · Brazil, Sao Paulo · Canada, Scarboro (Toronto) · South Africa, Springs · Switzerlaed, Geneva. · **Representatives Throughout the World.**

The Edwards System is the best and most modern sugar mill hydraulic system that can be purchased. The Edwards System has many advantages over all other kinds of mill hydraulics, viz.: Separate pressure on each ram improves mill work—No inertia—No Friction—No Moving Parts to wear out—Long Life with No Maintenance—Quick and Cheap to Erect—Saves Floor Space—Low Shipping Weight—Overall Cost much less than other types.

# Acclaimed throughout the World!




Hydro-Pneumatic Type Accumulator 195 lbs. (9 × 56 inches). Bladder Weight

* THE EDWARDS HYDRAULIC SYSTEM NOW INSTALLED IN OVER 460 FACTORIES

EDWARDS
ENGINEERING CORPORATION
1170 Constance Street • New Orleans 13, U.S.A.

* U.S. Patent 2,691,339; British Patent 678,053; French Patent 1,020,656; Cuban Patent 15,078; Mexican Patent 52,402; Patents Pending Other Countries.

# YORKSHIRE IMPERIAL METALS LIMITED

YORKSHIRE IMPERIAL

**place at your disposal**
**their long, specialised experience**
**in the metallurgical development**
**and manufacture of**

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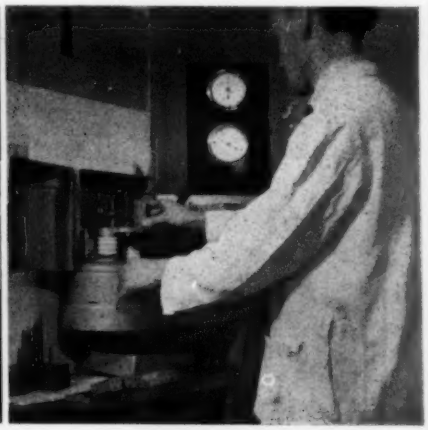
The resources of Yorkshire Imperial Metals Limited are devoted solely to the manufacture of non-ferrous tubes, plates and fittings, and plastic tubes and fittings. They have long been intimately associated with the Sugar Industry, both at home and overseas, and have made a careful study of the varied and often arduous operating conditions which obtain in the Industry. This study has resulted in the development of improved tube and plate alloys, metallurgically designed and scientifically manufactured to give the best possible service. This unrivalled experience is at your service, free of charge and without obligation, to assist in the solution of problems of all kinds affecting the life and use of non-ferrous tubes and plates.



*Yorkshire Imperial* craftsmanship, metallurgical skill and specialised experience, together with modern plant and methods and accurate control at every stage of manufacture, account for the enviable reputation which *Yorkshire Imperial* tubes and plates and *Yorkshire Imperial* fittings have achieved in their respective fields.

**TUBES IN "YORCORON" · "KUNIFER 10" · COPPER AND "SEVA" BRASS · PLATES IN A WIDE RANGE OF ALLOYS · BI-METAL TUBES AND PLATES.**

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**We deliver complete plants for the profitable utilization of**

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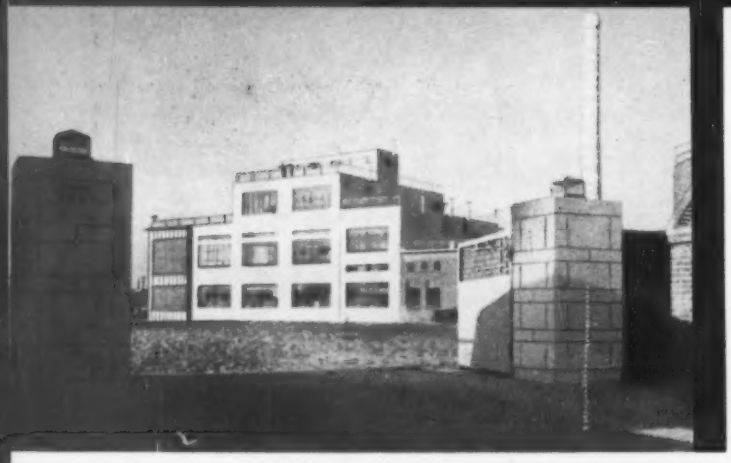
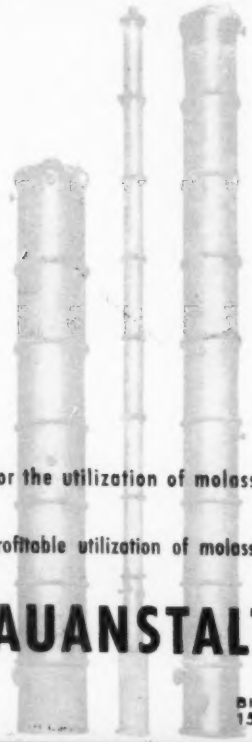
## molasses

| | | | |
|---|---|---|---|
| High-quality alcohol for human consumption and industrial use | rectified spirit 96,5 % vol. | active dry baker's yeast (saccharomyces) | In granules 92 % dry substance can be stored without losing its baking power |
| Used as power fuel for addition to motor car petrol | absolute alcohol 99,8 % | Baker's yeast (saccharomyces) | 28 % dry substance |
| For various industrial uses | glacial acetic acid 99 % | Nutrient yeast (torulopsis) | For human consumption high protein and vitamin content used as substitute for meat |
| Used as solvent for paint and lacquer industry | ethyl acetate | fodder yeast (torulopsis) | Used as additive to animal fodder with high protein and vitamin content |





Further plants for: $CO_2$ or dry-ice production · Utilization of slop

BMA is well-known for the delivery of complete sugar plants and plants for the utilization of molasses according to modern technology.

Our specialists will give you any detailed information you require for the most profitable utilization of molasses.

For further information write for our leaflet "Profitable Utilization of Molasses"

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BRAUNSCHWEIG · WESTERN-GERMANY

BMA 158

the experience of years!

# K.I.W.

## uses their years of experience in making

# SUGAR ROLLERS

MANUFACTURED AND RE-CAST
UNDER EXPERT SUPERVISION
TRIPLE CHECKING SYSTEM

OPEN GRAIN—EVEN WEAR
HIGHEST GRADE STEEL SHAFTS
MOST COMPETITIVE PRICES

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Under a single comprehensive contract, with undivided responsibility, 'ENGLISH ELECTRIC' undertake complete factory electrification.

**DIESEL ALTERNATOR SETS**
**STEAM TURBO ALTERNATOR SETS**
**TRANSFORMERS · SWITCHGEAR**
**FUSEGEAR · CONTROL GEAR · MOTORS**

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*Electrical Plant Division, Stafford*
WORKS: STAFFORD · PRESTON · RUGBY · BRADFORD · LIVERPOOL · ACCRINGTON

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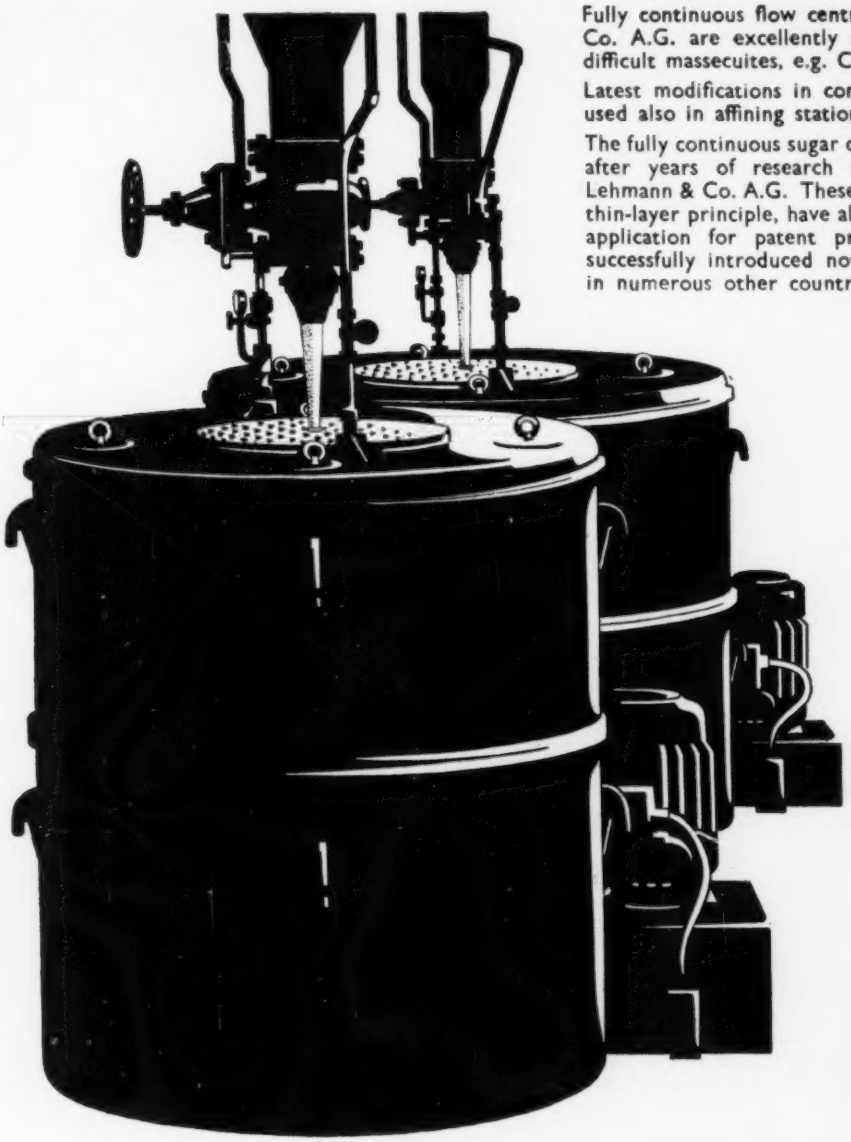

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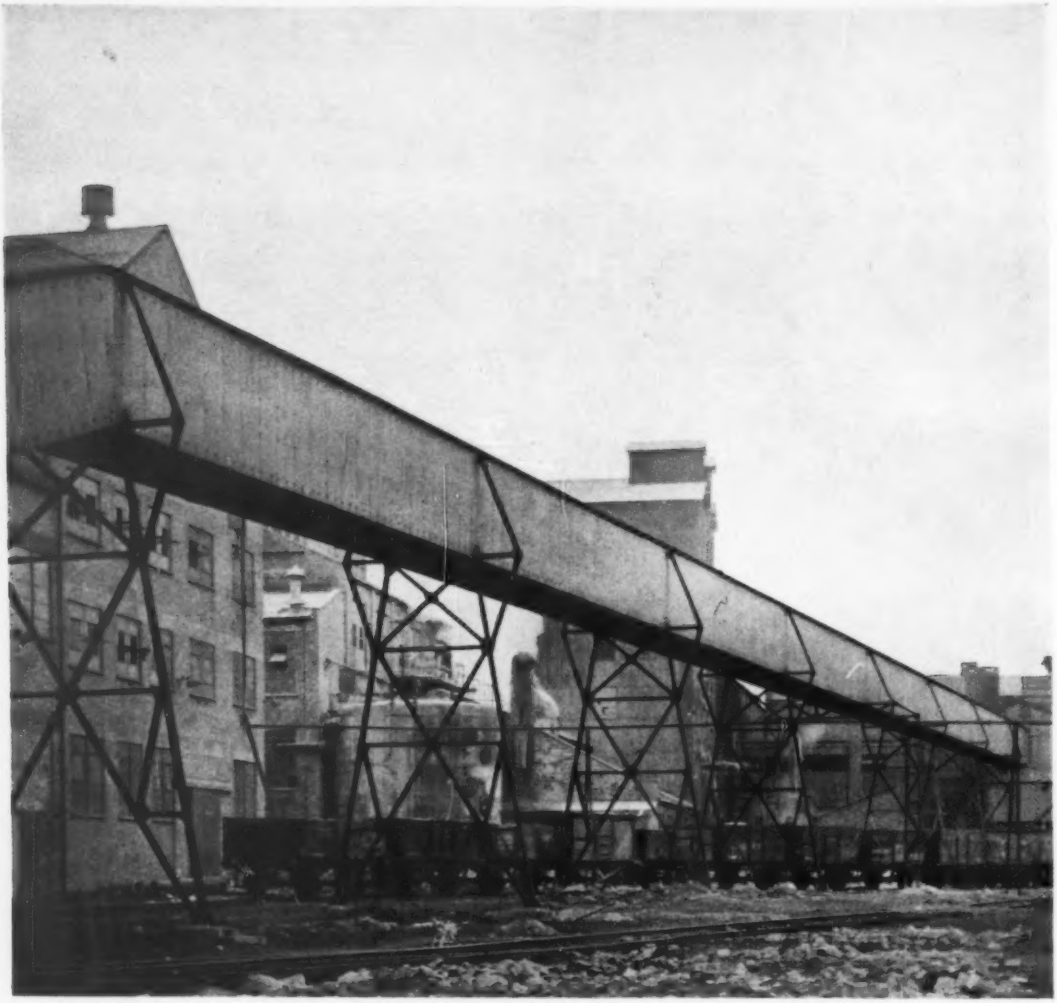

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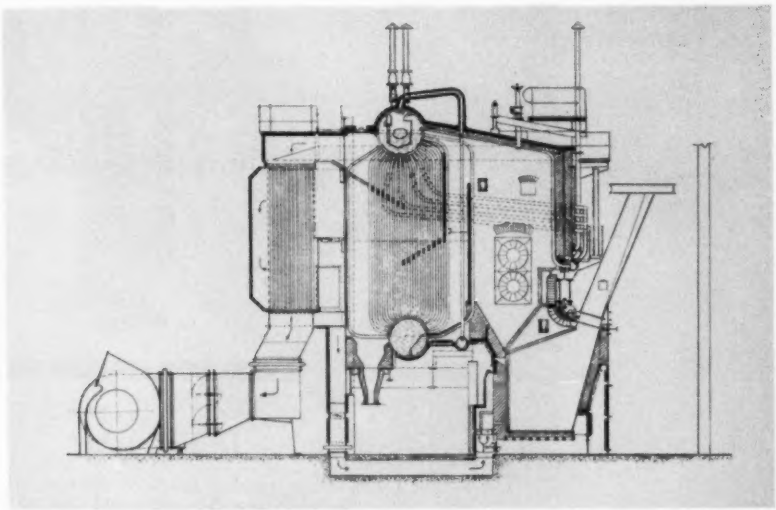

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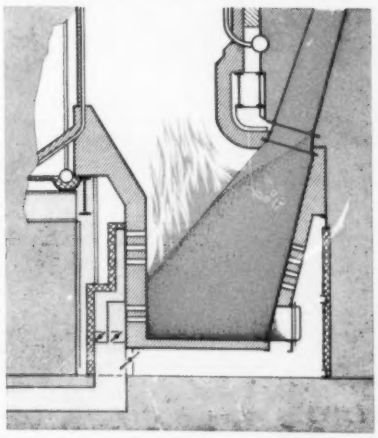

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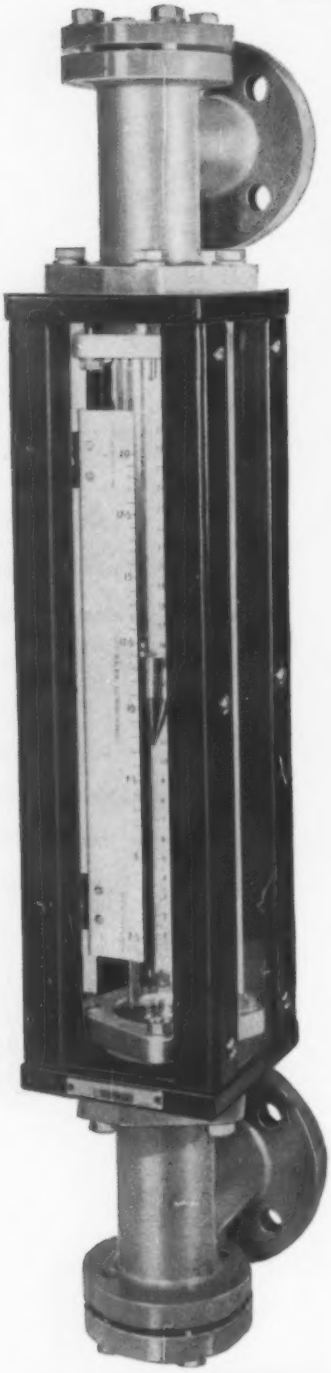

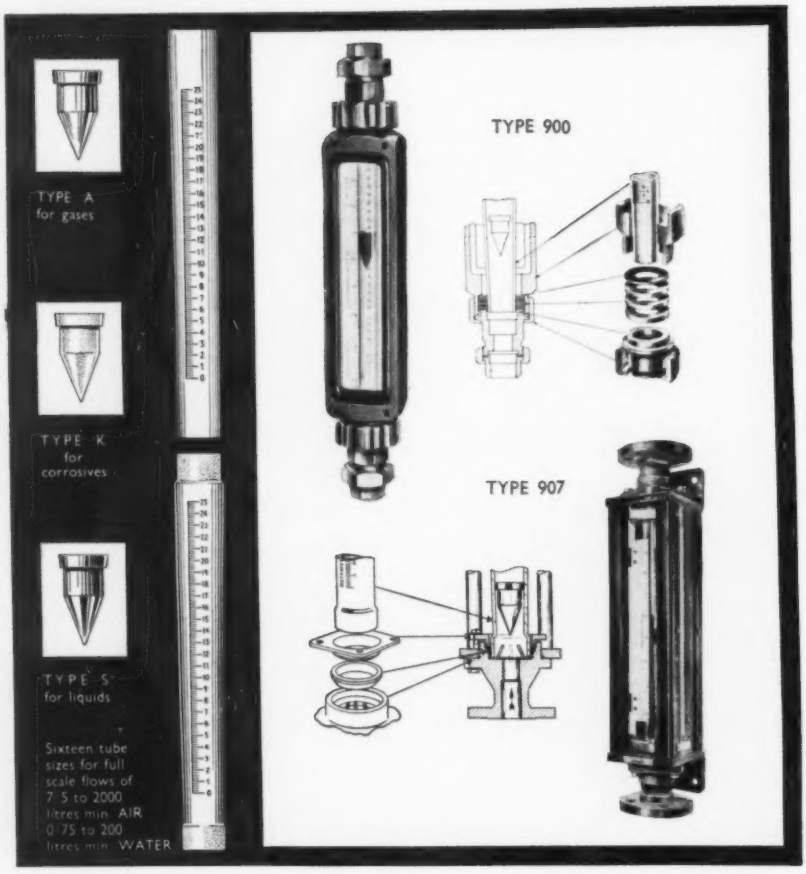


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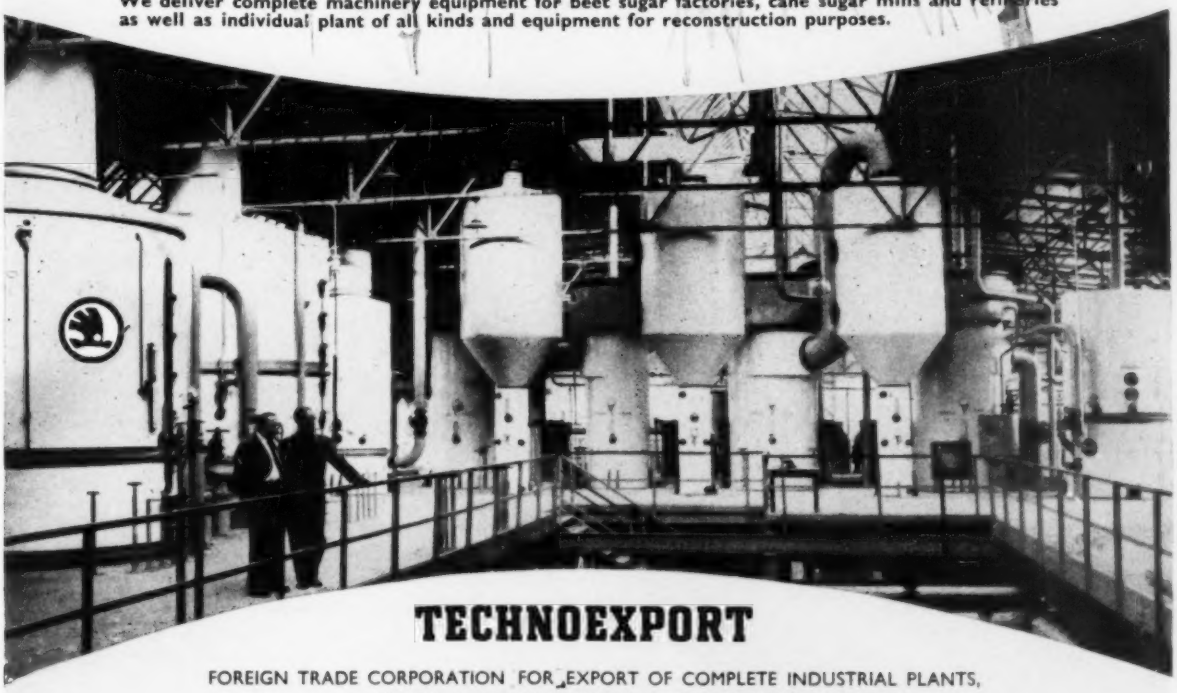

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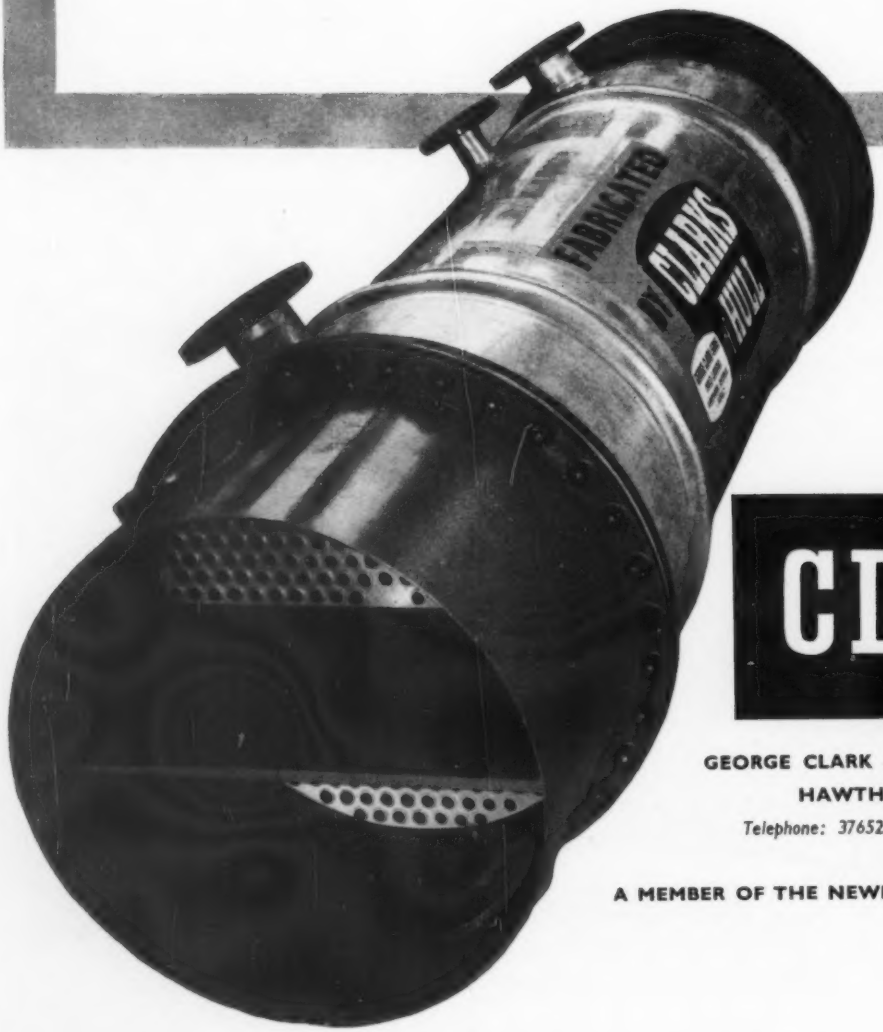


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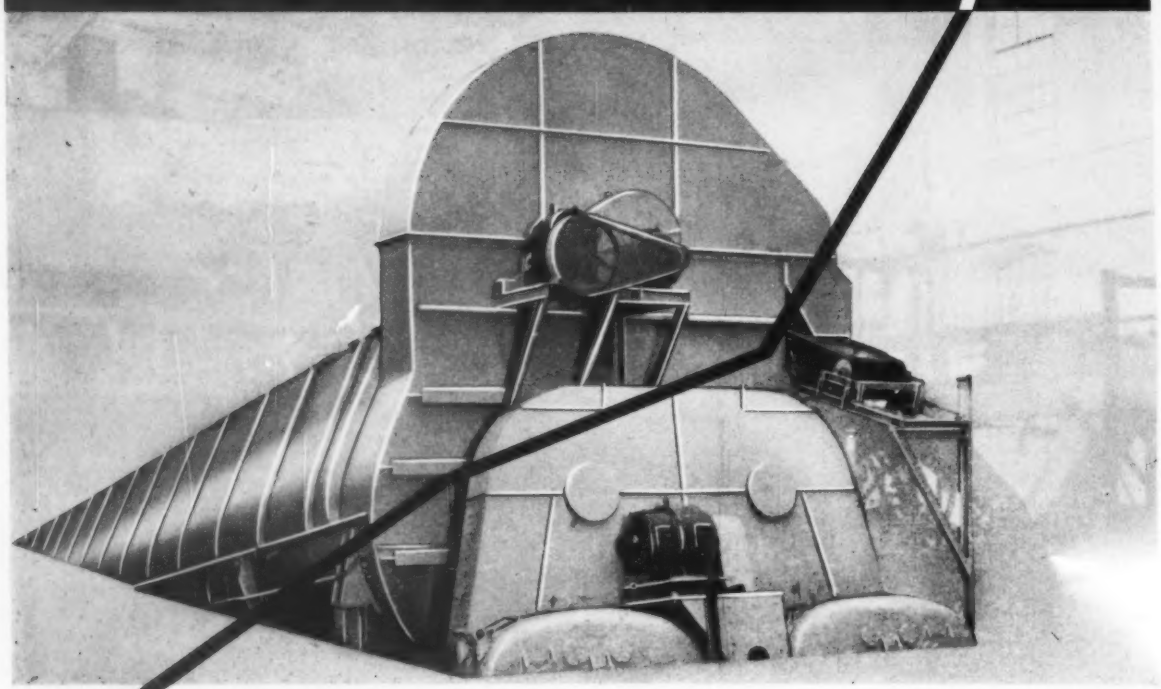

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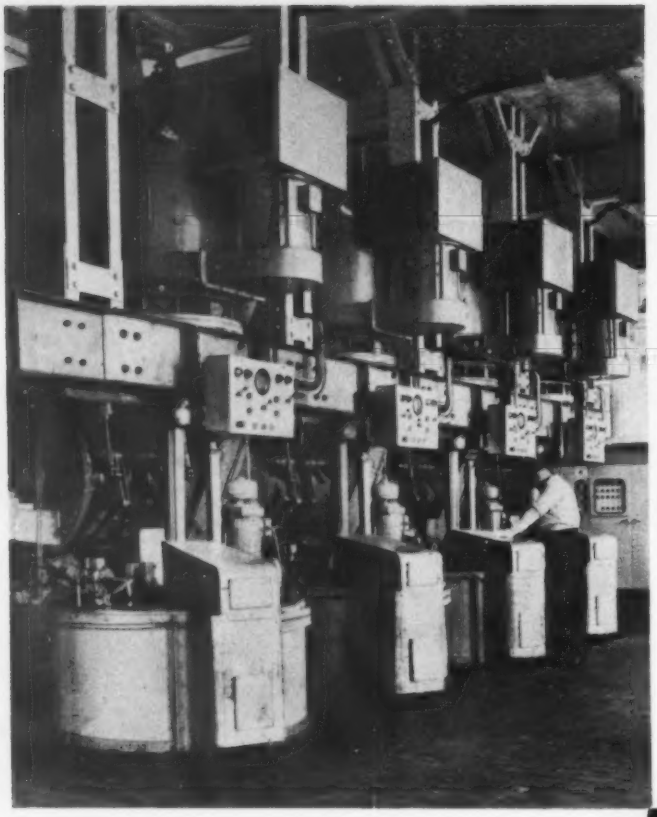

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# INTERNATIONAL SUGAR JOURNAL

VOL. LXIII JUNE, 1961 No. 750

## NOTES AND COMMENTS

**European sugar beet area.**

Elsewhere in this issue appear the first estimates by F. O. LICHT K.G.[1] of the areas sown to sugar beet in Europe. In view of the large crops produced in the 1960/61 campaign which in some cases have resulted in embarrassingly large stocks, it would seem strange that the total area is reckoned to be 85,000 hectares greater for 1961 than for 1960. However, of those countries classified under Western Europe only Spain and Yugoslavia are estimated to have appreciably bigger beet areas. The only large increase, in fact, is that given for the U.S.S.R., now estimated to have half the total Europe beet area by herself. Licht comments that this increase of 244,000 to a total of 3,300,000 ha is all the more conspicuous as the Soviet Union has undertaken to buy 2·7 million tons of Cuban sugar in 1961. Though 500,000 tons of this quantity will be re-exported to Mainland China under a recent trade agreement, the 1961 sugar supplies for covering the domestic requirements of the Soviet people will be far more abundant than in 1960.

C. Czarnikow Ltd.[2], calculating on the assumption that yields will be in line with the averages of the past five seasons, consider that the figures suggest little change in the East European outturn despite the enlarged area, while in Western Europe production will be down by about three million tons to 7,600,000 tons. If these figures should eventually prove to be reasonably accurate, the lower production would go some way towards eliminating the present heavy stock position of Europe although in some countries surpluses would continue to exist.

* * *

**U.S. non-quota authorization.[3]**

On April 14th, the U.S. Secretary of Agriculture, with the concurrence of the Secretary of State, authorized the purchase of 1,263,776 short tons, raw value, of non-quota sugar for importation during the remainder of this year. This follows the setting of quotas reported in our last issue[4]. Sugar requirements for 1961 were determined at 10,000,000 tons last December, while the combined total of quotas and non-quota allocations is 8,790,880. The difference comprises 1,000,000 tons of the quantity withheld from Cuba, 200,000 tons withheld from the Dominican Republic, and a total of 9120 tons of non-quota sugar from Belgium, Canada, Holland and the U.K., authorization of which has been deferred pending further study of conditions for authorizing such purchases in the light of the views of the Committee of Agriculture on measures to prevent trans-shipment of Cuban sugar through these countries. Quotas and non-quota allocations are listed below, the figures being given in short tons, raw value.

| | *Quotas* | *Non-Quota Allocations* | *Total* |
|---|---|---|---|
| Domestic Beet | 2,177,773 | — | 2,177,773 |
| Mainland Cane | 670,122 | — | 670,122 |
| Hawaii | 1,215,410 | — | 1,215,410 |
| Puerto Rico | 1,270,865 | — | 1,270,865 |
| Virgin Islands | 17,330 | — | 17,330 |
| Philippines | 980,000 | 340,731 | 1,320,731 |
| Peru | 121,507 | 544,870 | 666,377 |
| Dominican Republic | 111,157 | 222,723 | 333,880 |
| Mexico | 95,409 | 530,943 | 626,352 |
| Nicaragua | 17,471 | 25,897 | 43,368 |
| Haiti | 8,268 | 27,005 | 35,273 |
| Netherlands | 4,149 | 1,463 | 5,612 |
| Taiwan | 3,980 | 91,270 | 95,250 |
| Panama | 3,980 | 6,020 | 10,000 |
| Costa Rica | 3,968 | 16,282 | 20,250 |
| Canada | 631 | 1,266 | 1,897 |
| United Kingdom | 516 | 1,034 | 1,550 |
| Belgium | 182 | 361 | 543 |
| Hong Kong | 3 | 19 | 22 |
| British Guiana | 84 | 75,717 | 75,801 |
| B.W.I. | — | | |
| El Salvador | — | 12,000 | 12,000 |
| Guatemala | — | 12,000 | 12,000 |
| Brazil | — | 111,474 | 111,474 |
| Ecuador | — | 21,000 | 21,000 |
| Colombia | — | 21,000 | 21,000 |
| French West Indies | — | 25,000 | 25,000 |
| | 6,702,805 | 2,088,075 | 8,790,880 |
| | | Not yet authorized | 1,209,120 |
| | | | 10,000,000 |

[1] *International Sugar Report*, 1961, **93**, (4), 59.
[2] *Sugar Review*, 1961, (506), 85.
[3] *Lamborn*, 1961, **39**, 77.
[4] *I.S.J.*, 1961, **63**, 129.

**The 1960 sugar cane season in Australia.**[1]

The 1960 season's sugar production was the second highest in the industry's history, being exceeded only by the 1958 season's record outturn. Australian production is estimated at 1,383,000 tons 94 N.T., of which Queensland produced 1,320,000 tons and New South Wales 63,000 tons. This level of production is about 7½% greater than in 1959 season.

The acreage harvested in Queensland last season was somewhat higher than in 1959, 327,252 acres being harvested as against 299,732 acres in 1959 season. Apart from the latter season, the acreage harvested in Queensland last year was the lowest since 1952, notwithstanding the high level of sugar production.

The outstanding feature of the season was the high sugar content of the cane. In Queensland only 6·58 tons of cane were required to make 1 ton of 94 N.T. sugar. The previous record "low" of 6·73 tons of cane per ton of 94 N.T. sugar was established as far back as 1937. As a result of the very high sugar content in the cane, it was only necessary to crush an additional 250,000 tons of cane in Queensland last season to make 100,000 tons more sugar than in the 1959 season.

The conditions under which the 1960 Queensland crop was grown were not quite as favourable as those which produced the record yield of 28·12 tons of cane per acre in the 1959 season. However, the 1960 crop averaged 26·54 tons of cane per acre and sugar production per acre harvested was 4·03 tons 94 N.T., the second highest in the industry's history and only 0·03 tons less than the record 1959 yield.

Weather conditions during the crushing season were ideal for harvesting. This enabled the crop to reach a high peak of maturity and crushing proceeded with a minimum of lost time. Excellent supplies of high quality cane assisted the mills to achieve impressive crushing figures. For the first time in the industry's history an aggregate weekly crushing of 450,000 tons was exceeded, on six occasions, by the 31 Queensland mills, the highest weekly crushing being 455,895 tons. These performances are all the more remarkable when it is realised that there was virtually no overtime crushing last season.

The record cane/sugar ratio achieved in 1960 season was not entirely due to higher sugar content in cane. Great credit also goes to the mills for establishing a record level of sugar recovery in a season in which they also achieved their highest average crushing rate.

The very high rate of sugar manufacture last season created storage problems at mills and ports, and stocks of sugar awaiting shipment during the season reached an all-time record high. Total stocks of sugar for export in Australia at the end of December 1960 were 360,000 tons of actual sugar as compared with end-of-year export stocks of 359,000 tons in 1959 and 315,000 tons in 1958. (These tonnages include "fourth quota" sugar from the 1958 season.)

It is estimated that about 1,250,000 tons of cane were left unharvested in the 1960 season, which is about 1,000,000 tons less than the quantity of surplus cane left at the end of the 1959 crushing season. The increased acquisition of sugar last season was a help in relieving the surplus cane position but the very high sugar content in the cane had just the opposite effect. For example, if it had taken 7·34 tons of cane to make a ton of 94 N.T. sugar, that is, the actual Queensland average for the seasons 1954 to 1959, it would have been necessary to harvest an additional 1,002,000 tons of cane to make the same quantity of sugar.

The fact that substantially less surplus cane remained at the end of the 1960 season than in the 1959 season, despite the very high sugar content of the crop, shows that the industry is acting responsibly in regard to control of production.

It is interesting to note the large extent to which the industry last season handled, as stand-over cane, crops that were surplus to milling requirements in 1959. In the seasons 1955 to 1957 it was the practice to harvest about 200,000 tons of standover cane in Queensland each season, equivalent to about 2% of the crop. However, in 1960 season, no less than 942,206 tons of standover cane were harvested, equivalent to 10·8% of the crop. This shows that the extent to which crops are surplus to requirements cannot be judged by considering each season on its own. In each of the past three seasons a substantial proportion of the cane classified as unharvested or surplus was in fact crushed in the succeeding year.

Bulk handling advanced a further step last year with the completion of the Mourilyan Harbour terminal which came into operation in time to handle the 1960 season's production from Babinda, Goondi Mourilyan, and South Johnstone mills. This is the fifth bulk terminal to be erected in Queensland.

About 80% of the Queensland production was handled in bulk during the 1960 season. The existence of this new bulk terminal, with its 150,000 tons storage capacity, was the main factor which permitted record stocks of sugar to be held in Queensland during the crushing season.

Arrangements are now well advanced for the C.S.R. Company's New Farm refinery in Brisbane to handle its supplies wholly in bulk. Condong mill, in New South Wales, has been delivering raw sugar in bulk to New Farm refinery since 1956, but as from the commencement of the 1961 season all raw sugar from Moreton and Rocky Point mills, and about half the production of Maryborough mill, will also be despatched to New Farm in bulk. These new arrangements will enable about 85% of Queensland's production to be handled in bulk in future.

234,729 tons of cane were harvested mechanically last season, equivalent to 2·7% of the crop. The 11 Massey-Ferguson harvesters handled 68,944 tons, about 29% of the tonnage machanically harvested.

[1] *Australian Sugar J.*, 1961, **52**, 927–931.

Some of the eighteen Venton machines were not used for the whole of the season but despite this these machines harvested about 30,000 tons of cane. Fairymead machines harvested about 110,000 tons.

* * *

**Tate & Lyle Investments Ltd. 1960 report.**

*Raw sugar production*

In Jamaica, the West Indies Sugar Company had a better year than in 1959 and the trading results showed a modest improvement. Costs, however, both in factory and field were adversely affected by poor yields of sugar per ton of cane, due principally to weather conditions in December and January. These conditions also influenced juice quality in other Caribbean territories.

In Trinidad both Companies had a successful year. The 1960 crop, in contrast to 1959, was grown and reaped in almost ideal weather conditions. The yield of sugar per acre was higher than last year; the crops were comparatively free from damage by insect pest; and production of sugar by both Companies was a record. Labour relations have been excellent in spite of long negotiations for a new wage agreement. The 1960 crop having finished before the onset of the rains and the planting programme completed quickly, the prospects of another good crop in 1961 are favourable.

In Southern Rhodesia, Chirundu Sugar Estates have largely overcome their initial teething troubles and during the year produced nearly 10,000 tons of raw sugar, which is far in excess of any previous achievement. Rhodesia is at present in the throes of planning to become self-sufficient in sugar and in the process there is a danger of over-production. However, negotiations are at present in progress between the Producers, the Refiners and the Government which it is hoped will prove successful in avoiding this danger.

*Refined sugar production*

In December last Tate & Lyle acquired the balance of Shares in John Walker & Company not already held by either them or Tate & Lyle Investments. Tate & Lyle now own 51 per cent. of the Capital and Tate & Lyle Investments 49 per cent.

In the year to March, 1960, Canada and Dominion Sugar Company incurred a trading loss, as had been expected, but since then refining operations are again making profits. The Company, however, is still only breaking even on its beet operations, and it is hoped that negotiations now going on with the Federal Government will allow the industry to continue profitably.

Rhodesia Sugar Refineries Limited have maintained a steady expansion in output and have greatly increased their refining capacity with the opening of the Ndola refinery in Northern Rhodesia on 26th May 1960. Improvements are also planned for the refineries at Bulawayo and Salisbury to meet the increasing consumption of the Federation which is being stimulated by a vigorous sales policy.

*Sugar Machinery Manufacture*

The main contract carried out during the year by A. & W. Smith & Co. Ltd. was the design, supply, erection and commissioning of a new factory of modern design in Swaziland, capable of handling 300,000 tons of cane per year. More than half the contract value of £1,500,000 represented plant and machinery exported from the U.K.

* * *

**U.S.S.R. sugar loan to Mainland China.**[1]

It has been reported by the Soviet News Agency, Tass, that the Soviet Union is to supply China with 500,000 tons of sugar before the end of August on an interest free loan basis. This news has not received any particular prominence and with other factors affecting the market it is difficult to adduce whether it has had any effect on the price of sugar. Nevertheless, it is from many points of view an item of considerable interest in that it helps to clear up certain misconceptions. Earlier reports that the crop failure in China had been of wider proportions than was at first believed would certainly appear to be confirmed whilst the specification that delivery is to be effected within the space of five months makes it quite clear that the Chinese position is one of acute shortage. Any fears that may have existed that purchases of Cuban sugar by China would lead to the emergence of that country as an in-transit refiner would also appear to have been dispelled—at any rate for the time being. Indeed, the possibility must be borne in mind that China may present a regular and increasing outlet for world sugar as a result of changing dietary habits and an improvement in general living standards. It was only a few seasons ago that domestic production passed the million tons mark for the first time whilst maximum imports until last year were never in excess of some 200,000 tons. This year, whatever may have been the extent of the crop failure, China has already agreed to take one million tons from Cuba in addition to this 500,000 tons from Russia. The possibilities of this market can readily be seen when it is realized that if annual domestic consumption were raised even to India's modest 11 lb per head it would represent an overall demand of no less than 3·3 million tons.

It will be interesting to learn whether China will receive supplies from Russia or whether shipments from Cuba will be diverted to Chinese ports. In any case with the facts as they are presented at the moment it is difficult to see how this agreement can be reconciled with the statement made to the International Sugar Council at its ninth session in February of this year "that the purchases by the U.S.S.R. from Cuba were for internal consumption and that total exports from the U.S.S.R. would not exceed their customary level." The highest total of exports ever reported was reached last year when some 260,000 tons were dispatched and the market will welcome some clarification of the position.

[1] C. Czarnikow Ltd., *Sugar Review*, 1961, (503), 73.

# SUGAR CANE BREEDING IN BARBADOS

*Twenty-sixth Annual Report, British West Indies Central Sugar Cane Breeding Station*, 1958/59

THE report indicates considerable developments in the amenities available for the carrying out of the cane breeding programme. These include two additional buildings for lantern batteries and roofing a 42 ft × 50 ft area for potting cisterns, the latter giving a larger and higher ripening area for pollinated arrows, a rain-water collecting area to supply preservative solution and a preliminary cover for newly potted seedlings. The most important change in technique is an increased use of solution, five-gallon enamelled containers with drain plugs affording, with entire satisfaction, a valuable saving of time and labour in changing the solutions.

### *Seedling Raising and Elimination*

Arrowing was profuse and a record programme was carried through. In all 243 crosses, sib-crosses and selfs were made with the production of some 67 thousand seedlings raised at the station and some 107 thousand from fuzz sent to British Guiana, Jamaica and La Romana (Dominican Republic). Noteworthy in this crossing programme is the increased % derivatives of *S. sinense*; such derivatives figure largely in recent late-stage trials. These seedlings form the B. 61 series.

Of the B. 60 series, 7686 seedlings, or 15·4%, were carried to the first year trials and had yet to be harvested. Selections from the first year seedling trials (B. 59) numbered 248; of the characters involved in the selection, canes per stool ranged from 8 to 35 and weight per stool from 40 lb to 140 lb with the lowest accepted Brix 19·5. The results of the later trials (B. 58 to B. 54) are presented in tabular form on which it can only be noted here that of the B. 55 and B. 53 series no seedling survived the test, and of the B. 54 series four survived, B. 5401, B. 5480, B. 54142 and B. 54227.

The select seedling trials, the results of which are tabulated under the headings tons cane/acre, tons sugar/acre, % sucrose in cane, quotient of purity and number of rotten canes per plot, defy brief analysis, comprising as they do plant, first and second ratoons grown at 12 stations representative of areas of different rainfall. In general, attention is concentrated on B. 41227 and B. 49119, the latter already occupying 11% of the commercial cane area and, compared with B. 37161, giving yields of 107%, 117% and 111% in plant, first and second ratoon crops respectively.

### *Research*

Considerable attention has been given to the question of inbreeding with six seedlings of the B series ranging from the second to fifth generation. To these has now been added B. 43235, an attractive *officinarum-spontaneum-barberi* hybrid. While some of the lines show remarkable morphological similarity, closely resembling clonal plantings, other show appreciable morphological variation. A cytological basis for this is offered, "in strict polyploids the rate of progress $\frac{1}{4}$ towards homozygosity is expected to be slower than in the case of diploids. Where there is differential viability in favour of heterozygous genotypes, progress must be expected to be even slower."

The stage has been reached when crossing between inbreds and between male inbreds and female proven varieties (top-crosses) has become possible. One difficulty here lies in the fact that, owing to loss of vigour, inbreds normally have thin canes and weight of stool ceases to be a diagnostic character, but out-crossing hybrid vigour normally restores thickness.

Other cytological investigations concern the technique of fixing, and sectioning is preferred to the squash technique as being more reliable. Stem epidermis patterns and hair groups, among other morphological characters, have been studied as a means of variety determination.

A further investigation concerns the correlation between tillering of seedlings in pots and in the first year trials. The relationship appears to be somewhat complex but apparently is sufficient to be of value when there is an excess of seedlings.

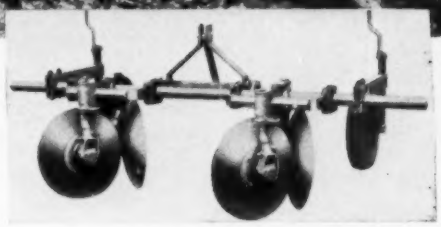
Other investigations briefly noted include correlation studies in nursery selections, bearing on the question of the need for making varietal selection under each of the varying ecological conditions, emasculation by means of "Dowpon" and the effects of heat treatment on arrowing.

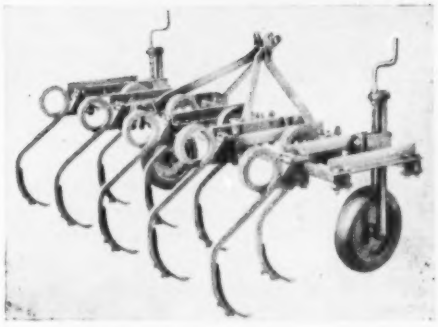
### *Varieties in Contributing Territories*

An indication of the varietal trend (% total acreage) is given by a comparison of the figures for 1958 and 1959. The interval is too short to give any reliable information but the most obvious trend is the progress of B. 41227 in Jamaica, where it was already the leading cane, in British Guiana where it is running B. 37161 close for top place and in Trinidad, where it occupies that position. The second significant trend is the drop, in some cases heavy, in acreage of B. 37161 in all territories.

**Indian sugar production 1959/60**[1].—In the season which ended in October 1960 total sugar production was 2,420,872 tons, compared with 1,918,192 tons in 1958/59, i.e. an increase of 502,680 tons or 26·20%. Sugar factories operating numbered 167 and 25,519,000 tons of cane were crushed as compared with 19,487,000 tons of cane crushed by 163 factories in the previous season. Average sugar recovery was 9·91% compared with 9·85% in 1958/59.

[1] *Indian Sugar*, 1960, **10**, 565.





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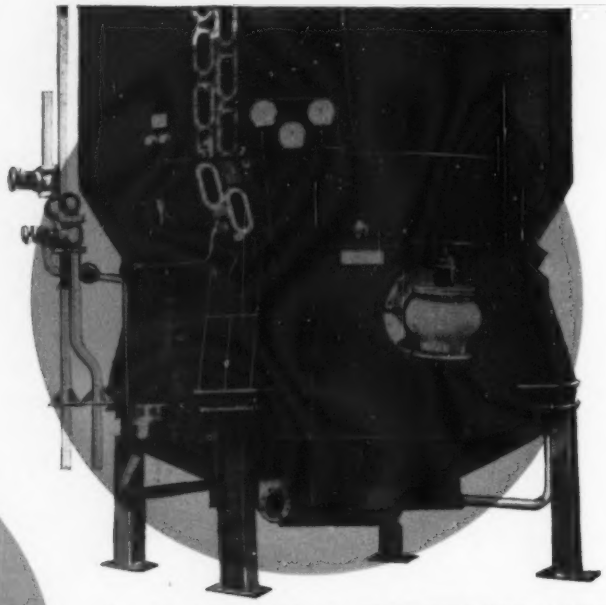

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# SOME OBSERVATIONS ON THE EFFECTS OF FREEZES ON THE SUGAR CANE IN TUCUMAN

By Dr. WILLIAM E. CROSS

SINCE I first came to Tucumán many years ago I have been impressed by the long periods which elapse before cane left standing after having been subjected to severe freezes, becomes decomposed and unsuitable for sugar manufacture.

I first noticed this in the year 1918, when the following minimum temperatures were registered in the fields of the Tucumán Experiment Station:

| | |
|---|---|
| June 24th | 27·5°F |
| July 7th | 23·0°F |
| July 8th | 19·8°F |
| July 9th | 24·8°F |
| July 10th | 27·5°F |
| July 11th | 27·3°F |

These freezes killed all the leaves of the cane, which presented a completely whitened appearance, no traces of green being visible.

To make matters worse, the cold spell was followed, in the second half of July, by very hot weather, with maximum temperatures ranging between 86°F and 91·5°F, and also by another hot spell in the last week in August, when the maximum temperatures varied between 86°F and 95°F, all of which one would suppose would have tended to accelerate the decomposition of the frozen cane. Nevertheless, the purity of the stubble cane[1] of our then principal varieties POJ 36 and POJ 213, harvested at the end of August and early in September, was in most cases well over 80%. (The plant cane on the other hand did not hold up so well, as its purity had dropped to around 70%, so that it was hardly fit for grinding.)

In 1920 similar surprising results were obtained. In the middle of July, we had a heavy snowfall, and minimum temperatures of 24·3°F, 24·8°F and 25·7°F, on three succeeding nights, also followed by hot weather (on the 21st July the maximum temperature was 94·1°F), and also by rainy spells at the end of July, and especially from the 29th August to the 6th September, when we had 5·3 inches. The leaves of the cane, completely whitened by the freezes, took on a dirty yellow colour after the rains, and the fields presented a very desolate appearance. Nevertheless, the cane continued to be in quite good condition for the factory until well into October, or even later, as the following analyses show:

| *Date of Analysis* | *Brix %* | *Polarization %* | *Purity %* |
|---|---|---|---|
| | **POJ 36** | | |
| October 7th | 15·77 | 13·39 | 81·90 |
| October 14th | 14·82 | 12·88 | 86·90 |
| October 21st | 14·71 | 12·77 | 86·81 |
| November 4th | 11·53 | 9·61 | 83·34 |
| November 18th | 11·30 | 7·80 | 69·02 |
| December 2nd | 9·85 | 5·81 | 60·09 |
| | **POJ 213** | | |
| October 7th | 14·27 | 11·80 | 82·69 |
| October 14th | 13·85 | 10·62 | 76·67 |
| October 21st | 13·01 | 10·18 | 78·24 |
| November 4th | 11·35 | 8·50 | 74·88 |

In 1921 we also had a very severe winter, as between the 16th June and the 6th July it froze on sixteen nights, with temperatures as low as 21·2°F on 4th July, 24·8°F on 16th June, and 26·6°F on the 5th July. After these freezes all the cane lost its green colour, and presented a completely whitened appearance. All this notwithstanding, the standing cane, analysed some two months later, was in excellent condition, as the following figures show:

| *Date of Analysis* | *Brix %* | *Polarization %* | *Purity %* |
|---|---|---|---|
| | **POJ 36** | | |
| September 1st | 17·81 | 15·71 | 88·20 |
| September 8th | 17·28 | 15·72 | 90·97 |
| September 20th | 16·97 | 13·57 | 79·96 |
| | **POJ 213** | | |
| September 1st | 17·74 | 15·39 | 86·75 |
| September 9th | 17·84 | 16·11 | 90·30 |
| September 14th | 16·53 | 14·66 | 88·68 |
| | **POJ 234** | | |
| September 1st | 16·39 | 14·17 | 86·45 |
| September 16th | 16·67 | 15·34 | 92·02 |

Similar results were also obtained in the next freeze year, 1933, not only with the POJ varieties mentioned, but also with others which were coming into commercial cultivation, such as Co. 270, Co. 281, POJ 2725, POJ 2878 and Tuc. 472. In that year, in which we had five freezes in June, including one of 23·4°F, and freezes on nine consecutive nights in July, including one of 24·8°F and another of 25·5°F—followed by very hot spells in August, with maximum temperatures up to 96·4°F—we continued to make analyses of these canes, which were left standing, until the first week in November. In general the purities remained above 80% until the second half of October, but after that the canes suffered rapid decomposition, so that in a few days they became quite unsuitable for sugar manufacture.

Similar observations were made in the severe freeze years of 1942, 1944, 1945, 1952 and 1955, but we will limit ourselves to giving some data of this latter year, in which the winter was exceptionally severe, a freeze of 28·4°F being registered on the 22nd June, two of 24·8°F, and two of 26·6°F in the first week in July, one of 23°F on the 28th of that month, and one of 19·4°F on the 29th—and finally four nights of freezes in the first week of August, including one of 19·4°F on the 6th. In spite of all this, the cane of all but the most susceptible varieties, left standing until it could be harvested, remained in good condition for grinding until the end of August and the beginning of September, although after that time it began to deteriorate rapidly.

[1] Unless otherwise stated, all the data given in this article refers to stubble cane, which normally constitutes 90% or more of all the cane ground.

**Table 1**

| *Year* | *Variety* | *Age of Cane* | *Date of Analysis* | *Brix %* | *Polarization %* | *Purity %* |
|---|---|---|---|---|---|---|
| 1933 | Kavangire | 2nd stubble | 7th July | 16·87 | 12·77 | 75·69 |
| ,, | ,, | ,, | 29th July | 16·61 | 13·61 | 81·93 |
| ,, | ,, | ,, | 11th August | 16·79 | 14·31 | 85·22 |
| ,, | Tuc. 1111 | Plant | 16th June | 14·97 | 12·64 | 84·43 |
| ,, | ,, | ,, | 18th August | 16·40 | 14·34 | 87·43 |
| ,, | Tuc. 1296 | 1st stubble | 17th June | 15·38 | 12·64 | 82·18 |
| ,, | ,, | ,, | 25th August | 17·23 | 14·73 | 85·49 |
| ,, | Tuc. 1400 | Plant | 16th June | 12·74 | 9·67 | 75·90 |
| ,, | ,, | ,, | 18th August | 15·01 | 12·03 | 80·14 |
| ,, | Zwinga | 2nd stubble | 11th July | 14·50 | 9·97 | 68·75 |
| ,, | ,, | ,, | 11th August | 15·56 | 12·30 | 79·04 |
| 1944 | Tuc. 1406 | 4th stubble | 15th June | 16·73 | 14·58 | 87·15 |
| ,, | ,, | ,, | 9th September | 19·48 | 16·80 | 86·24 |
| ,, | ,, | ,, | 19th September | 22·71 | 20·28 | 89·30 |
| ,, | Tuc. 2645 | 2nd stubble | 4th July | 15·38 | 12·07 | 78·48 |
| ,, | ,, | ,, | 4th August | 16·55 | 14·17 | 85·62 |
| ,, | Tuc. 2701 | ,, | 4th July | 14·68 | 11·71 | 79·77 |
| ,, | ,, | ,, | 8th August | 16·90 | 13·81 | 81·72 |
| ,, | Tuc. 2705 | ,, | 4th July | 13·29 | 10·39 | 78·18 |
| ,, | ,, | ,, | 2nd August | 14·96 | 12·24 | 81·82 |

After the severe freezes of all these years, which had the effect of killing the terminal bud of the cane, and killing all the leaves, which were completely whitened, losing all their green colour, while the interior of the lateral buds became quite black, it appeared probable that no further ripening could take place. On the other hand the high purities which many canes had in September and even October, were in many cases superior to those which they usually have attained in the period when the freezes occurred, making it appear that they continued to ripen even after having been "frozen". We decided to investigate this possibility, by making analyses of the cane of different varieties in the period of the freezes, and others several weeks later. As will be seen from the data given in the following table, in many cases the canes were definitely richer in sugar and of higher juice purity in the later analyses, indicating that the ripening process had continued after the freezes[2] (Table 1).

Another matter which I found very impressive was the fact that these severe freezes did not seem to affect the production of the cane in the succeeding years. A rather startling evidence of this is to be found in the results obtained from a plot of Kavangire cane which was planted in the Tucumán Experiment Station in the year 1910, and continued as stubble, being duly cultivated and harvested each year, for 25 years, during which time it was exposed to the many severe freezes experienced during that long period. Nevertheless, the average production of each of the 25 annual crops was more than 58 metric tons of cane per hectare, and the average yearly production in the last four years was slightly over 60 tons per hectare[3]. Similar results were obtained in plots of POJ 36 and POJ 213, also planted in 1910, and harvested each year until 1923, during which time the cane was exposed to the severe freezes of 1918, 1920, 1921, etc. In the last year, 1923, as 12th year stubble, both these canes gave more than 55 metric tons of cane, and six tons of sugar per hectare[4]. In the same way the newer varieties I planted in 1947 in my new experimental farm, in many different plots, were continued as stubble for eight years, during which period they were exposed to the very severe freezes of 1952, and especially 1955. Nevertheless, these canes, in the harvest of 1956, as eighth year stubble, still gave acceptable yields, as is seen from the following average results of some of the more commonly grown varieties:

| *Variety* | *Average yield per hectare (tons)* | |
|---|---|---|
| | *Cane* | *Sugar* |
| Co. 290 | 52·065 | 5·378 |
| Co. 413 | 75·780 | 7·578 |
| Tuc. 1149 | 63·358 | 5·072 |
| Tuc. 2645 | 46·610 | 4·272 |
| Tuc. 2680 | 43·890 | 3·480 |
| Tuc. 2683 | 54·630 | 4·125 |
| Tuc. 3197 | 67·860 | 5·375 |
| Tuc. 3342 | 79·065 | 8·080 |
| Tuc. 4441 | 101·385 | 5·233 |

We also made interesting observations on the effect of leaving the frozen cane standing until the next harvest, analysing it periodically during the second year. When this is done with unfrozen cane, the purity of the juice remains almost constant during the whole year, although the Brix % and Polariza-

[2] The freezing temperatures registered in 1933 are given in a previous paragraph; in 1944 a minimum temperature of 25·9°F was registered on July 9th, besides other freezes.

[3] *Rev. Ind. y Agric. de Tucumán*, 1936, **26**, 82–83.

[4] *ibid.*, 1923, **13**, 211–213.

tion % become markedly reduced during the rainy season, only to increase again after this period is over, and the winter season begins. An experiment made with POJ 36 will illustrate this:

| *Date of Analysis* | *Brix %* | *Polarization %* | *Purity %* |
|---|---|---|---|
| 9th October | 21·78 | 18·68 | 85·76 |
| 6th November | 21·17 | 18·12 | 85·59 |
| 4th December | 20·07 | 17·34 | 83·39 |
| 2nd January | 16·66 | 14·34 | 86·07 |
| 5th February | 13·37 | 10·48 | 78·38 |
| 4th March | 11·85 | 8·95 | 75·52 |
| 6th April | 13·18 | 10·23 | 77·61 |
| 7th May | 13·22 | 10·72 | 81·08 |
| 2nd June | 17·07 | 14·14 | 82·83 |
| 26th July | 16·91 | 14·71 | 86·98 |

But when the cane left standing has suffered the effects of severe freezes, the results of such analyses are very different, for while the sucrose content and purity is maintained until October or sometimes even later, afterwards these values suffer a sudden drop, until the canes contain very little sugar. (At the same time they shed all their leaves, which are quite killed by the freezes, and also the top joints fall off, leaving the rest of the stalks blackened, and apparently quite dead.) But afterwards a very curious phenomenon is observed: as the winter approaches, these blackened stalks acquire anew a considerable sugar content and a good purity, so that at the time of the harvest their juice is quite suitable for sugarmaking, although the proportion of juice contained in the cane is low. (We have tried to explain this by supposing that transfusion takes place, of the juice of the new stalks which have sprouted from the stubbles.) These changes are well shown by the following results obtained with POJ 36 cane after the severe freezes of the year 1933:

| *Date of Analysis* | *Brix %* | *Polarization %* | *Purity %* |
|---|---|---|---|
| 12th September 1933 | 15·77 | 13·80 | 87·50 |
| 10th October 1933 | 14·23 | 11·76 | 82·64 |
| 7th November 1933 | 10·42 | 3·10 | 29·75 |
| 5th December 1933 | 8·07 | 2·19 | 27·13 |
| 5th January 1934 | 10·98 | 6·40 | 58·28 |
| 12th April 1934 | 13·24 | 10·34 | 78·10 |
| 1st May 1934 | 16·36 | 13·88 | 84·84 |
| 29th May 1934 | 16·02 | 13·69 | 85·45 |

The plot of cane from which these samples were taken for analysis, which was left standing after the freezes of 1933 until the harvest of 1934, produced a large number of new canes which sprouted from the stubbles, and these grew rapidly, converting the appearance of the field from that of a cemetery of dead canes which it had in the earlier months of the agricultural year, to that of a flourishing plot of healthy green cane, in which the old stalks were almost completely hidden by the new leafy green ones, being hardly distinguishable in appearance from that of another part of the plot in which the frozen cane had been cut and removed from the field, and cultivation carried out in the usual way. We harvested the whole plot on the 7th August, 1934, separating the old stalks from the new, and weighing and analysing each group separately. The average results obtained are given in Table 2.

A field of sugar cane in Tucumán after the heavy snowfall of 10th July, 1920

These results indicated that in this way might be found a practical solution to the serious problem of the cane growers, of what to do with fields of frozen cane, which could not be harvested before decomposition set in, as the cost of cutting such cane and removing it from the fields, and then cultivating as usual, is very considerable. This solution would be to leave standing the fields of frozen cane until the following harvest, and then cut and send to the mill both the old and the new stalks, when the whole would give a juice acceptable for sugarmaking, although the juice extraction obtained from the old stalks would be rather low. For this reason we thought it worthwhile to repeat the experiment with other varieties, which we did in 1945, after the severe freezes of that year, which included one of 25·7°F on the 9th July, and one of 26·6°F on the 22nd June. In one experiment, in a field of Tuc. 1406, a part of the cane was left standing until the harvest of 1946, when as in the other experiment the whole of the cane was cut, and the old stalks separated from the new, and weighed and analysed. In another part of the field the cane was cut and removed from the field, and cultivation carried out in the usual way. The results obtained are shown in Table 3 (date of harvest, 12th July, 1946).

**Table 2**

| | *No. of stalks per hectare* | *Kilos cane per hectare* | *Analysis of Juice* | | |
|---|---|---|---|---|---|
| | | | *Brix %* | *Polarization %* | *Purity %* |
| **Part left standing after the 1933 crop—** | | | | | |
| Old stalks | 56,145 | 13,970 | 15·81 | 12·73 | 80·52 |
| New stalks | 69,795 | 34,155 | 20·75 | 18·58 | 89·54 |
| **Part cropped in 1933, and cultivated as usual—** | | | | | |
| | 81,070 | 36,850 | 20·57 | 18·42 | 89·55 |

**Table 3**

| | *No. of stalks per hectare* | *Kilos cane per hectare* | *Analysis of Juice* | | |
|---|---|---|---|---|---|
| | | | *Brix %* | *Polarization %* | *Purity %* |
| **Part left standing after the 1945 crop—** | | | | | |
| Old stalks | 50,722 | 23,055 | 12·87 | 10·88 | 84·54 |
| New stalks | 108,500 | 72,167 | 16·21 | 13·72 | 84·63 |
| **Part cropped in 1945, and cultivated as usual—** | | | | | |
| | 126,667 | 73,222 | 16·33 | 13·98 | 85·61 |

**Table 4**

| *Variety* | *Old or New stalks* | *No. of stalks per hectare* | *Kilos cane per hectare* | *Analysis of Juice* | | |
|---|---|---|---|---|---|---|
| | | | | *Brix %* | *Polarization %* | *Purity %* |
| **Experiment I—** | | | | | | |
| Tuc. 2645 | Old | (*) | 18,889 | 16·43 | 14·02 | 85·33 |
| ,, | New | 104,444 | 70,000 | 18·58 | 16·26 | 87·51 |
| Tuc. 2651 | Old | 94,444 | 25,556 | 14·47 | 12·35 | 85·35 |
| ,, | New | 182,222 | 106,667 | 14·27 | 11·19 | 78·42 |
| Tuc. 2657 | Old | 74,444 | 27,778 | 15·87 | 13·86 | 87·33 |
| ,, | New | 225,556 | 130,000 | 15·95 | 13·44 | 84·26 |
| Tuc. 2680 | Old | 95,556 | 48,889 | 13·75 | 11·21 | 81·53 |
| ,, | New | 173,333 | 116,667 | 15·42 | 12·49 | 81·00 |
| **Experiment II—** | | | | | | |
| Tuc. 2645 | Old | 31,944 | 16,278 | 17·14 | 15·37 | 89·67 |
| ,, | New | 97,222 | 69,556 | 18·60 | 16·25 | 87·37 |
| Tuc. 2680 | Old | 61,111 | 32,500 | 14·35 | 12·00 | 83·62 |
| ,, | New | 138,167 | 78,833 | 15·35 | 12·55 | 81·76 |
| Tuc. 2683 | Old | 70,389 | 38,889 | 15·62 | 13·56 | 86·81 |
| ,, | New | 152,614 | 100,389 | 16·57 | 13·81 | 83·34 |

* Not determined.

In two other experiments, with various types of cane, the frozen cane was left standing after the winter of 1945, in the same way, except that the cutting and cultivating a part of each plot was omitted. In the harvest, which took place between the 10th and the 12th July, 1946, the results obtained were as in Table 4.

Another observation we made in all these experiments, was that the new canes which sprouted from the stubbles of the cane left standing, developed definitely more quickly than those in the part of the field where the cane had been cut and cultivated in the usual way, making it appear that the juice of the old stalks, by transfusion, nourished the new ones, and stimulated their growth. In the two experiments in which a part of the field was cut and cultivated, the average weight of stalk of this cane was definitely less than that of the new stalks produced in the part left standing.

Finally we may mention some observations we made regarding the effects of the freezes on the cane, from the point of view of its suitability for planting. The severe freezes mentioned in this article had the effect of killing the terminal buds of the cane, and apparently also the lateral buds, the tissues of which took on a dark brown, almost black, colour, making the buds appear to be dead. But in many cases, if the cane was left standing, a ring of green tissue was formed around the damaged part, which in time appeared to be absorbed, and tended to disappear. When such cane was used for planting, it usually sprouted well. But even when the freezes were so severe that they really killed some of the buds, these were always those of the top part of the stalk, the lower buds retaining their germinating capacity, so much so that in none of the severe freeze years mentioned in this article was the lower third of the stalk unsuitable for planting.

We also observed that the freezes, when they did not actually destroy the buds, seemed to have a definite stimulating effect on the cane, so much so that many fields planted with such cane were more productive than those planted with cane which had not been exposed to the frost. This benefit was so striking, that it made one think that it might be advantageous to submit all cane to be used for planting to a low temperature of say around 27°F, for a short time, in cold storage, before the planting is carried out. I wanted to try this out experimentally, but never got the opportunity.

In a previous article published in this journal[5] I tried to show that the varietal yield decline which seems to occur inevitably in most cane producing countries, has not been observed in the Argentine. May it not be that the stimulating effects of the frequent freezes has at least some influence in bringing about this favourable situation?

[5] *I.S.J.*, 1960, **62**, 87–88.

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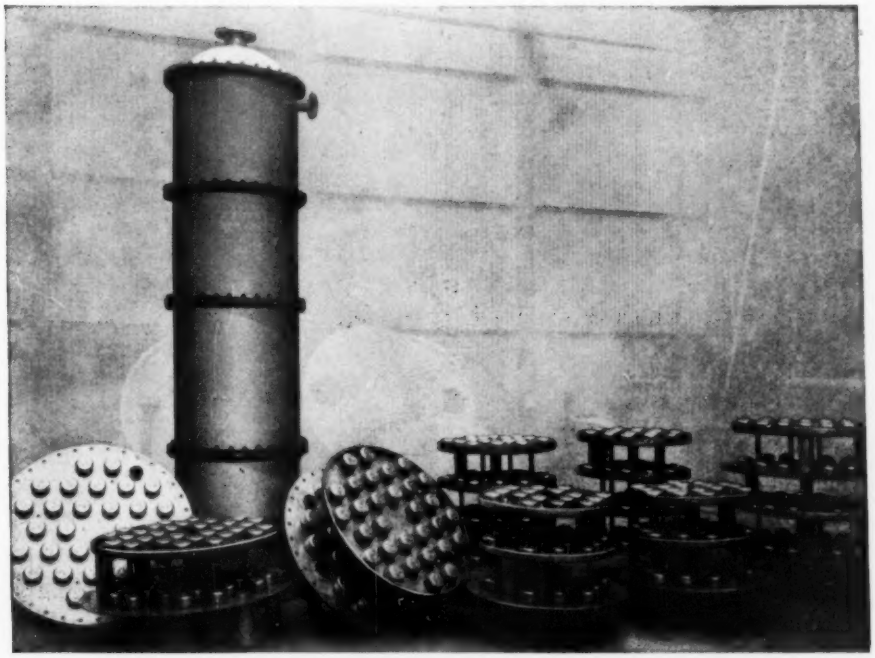

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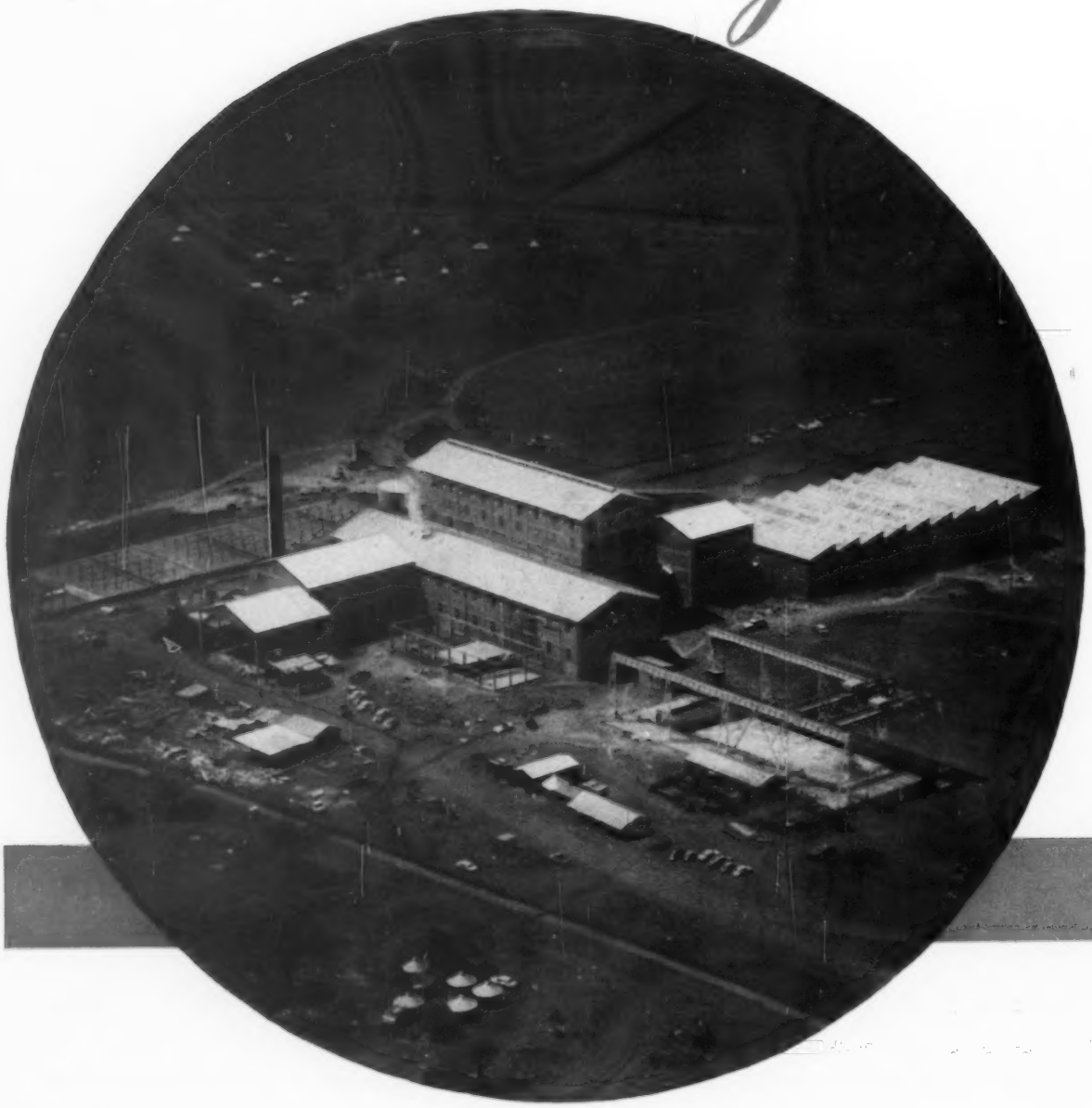

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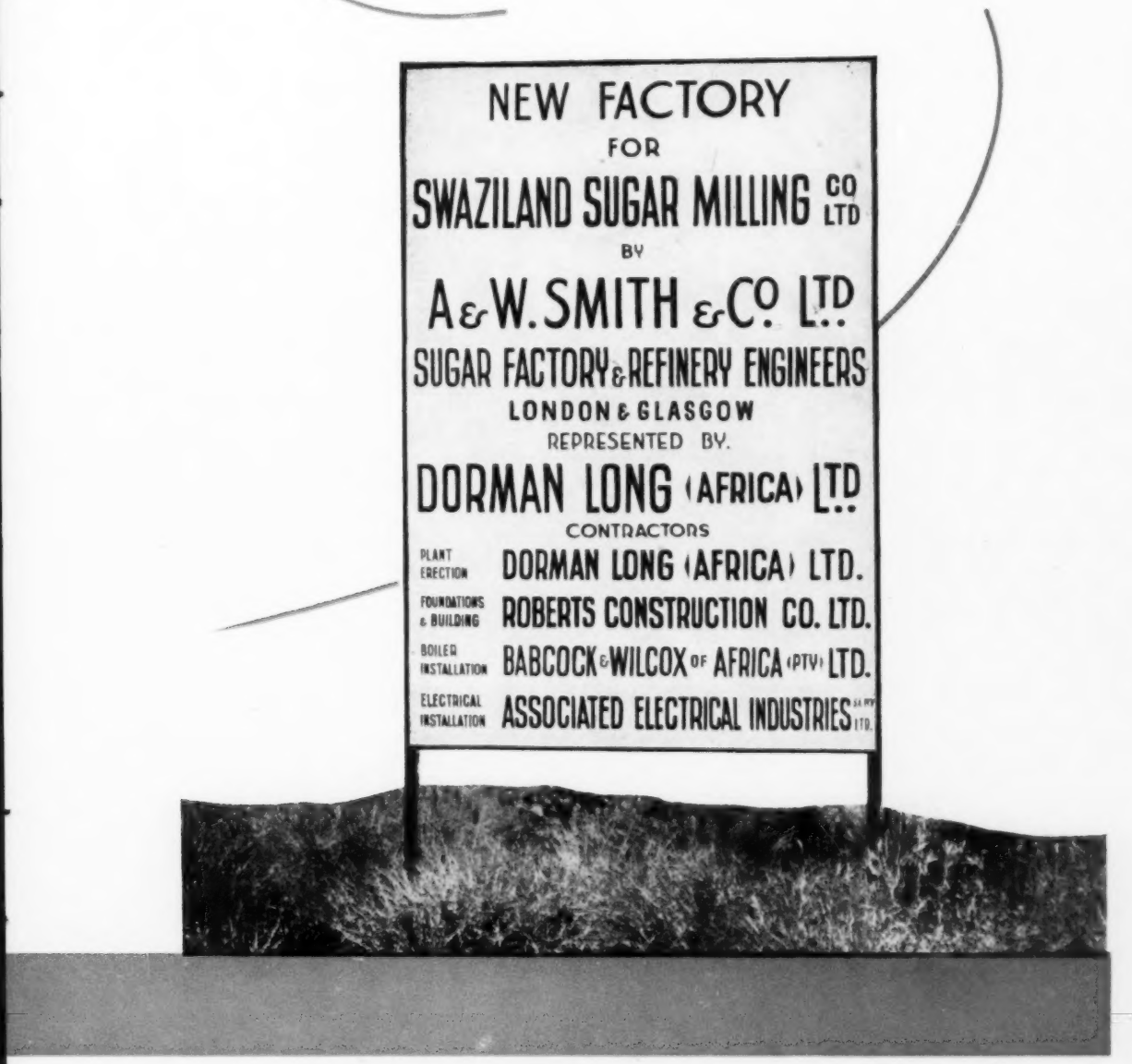


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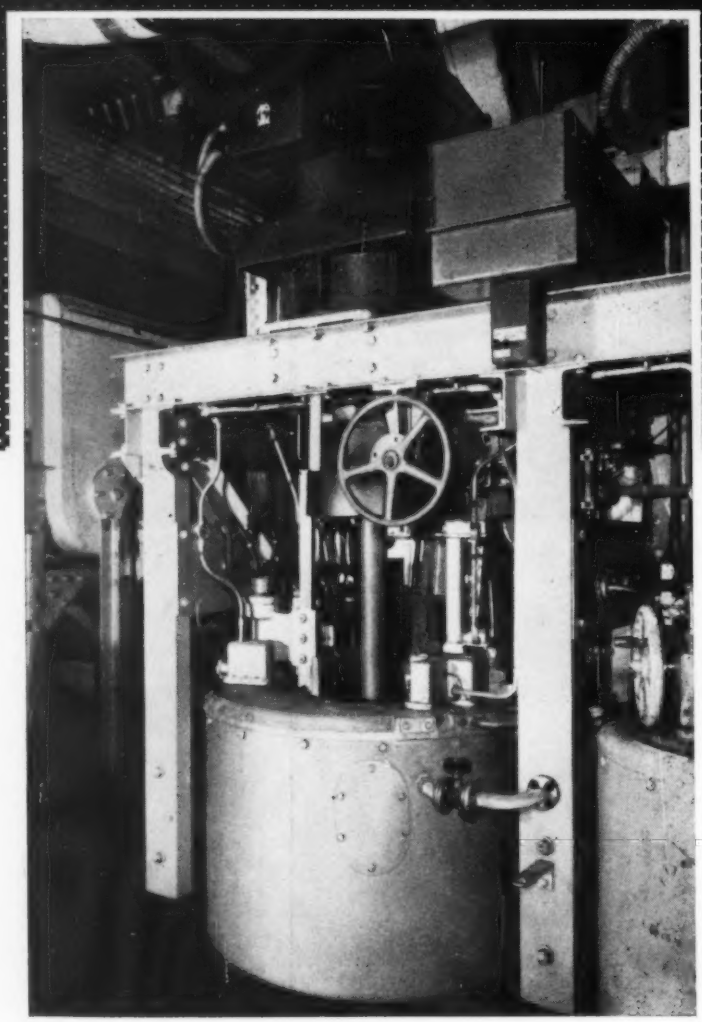

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**Direct and residual effects of *Striga* control treatments on Sorghum yields.** ANON. *Trop. Agric.*, 1961, **38**, 49–56.—In view of a previous abstract[1], this account of investigations in the Sudan is of some interest.

* * *

**Comparison of flowering of healthy and RSD-infected sugar cane.** P. H. DUNCKELMAN and E. H. TODD. *Sugar J.* (La.), 1960, **23**, (5), 28–30.—A significant increase in the degree of flowering was found in ratoon stunting disease-infected CP 29-320, when grown on certain classes of soil, and varying results were obtained with CP 44-155 and F 36-819. Other varieties showed no difference.

* * *

**Research and field practice.** T. G. CLEASBY. *The Condenser*, 1960, **4**, (3), 35–42.—The article forms a comprehensive review of the progress made in all branches of the sugar industry with especial reference to the Tongaat Sugar Company's estates.

* * *

**Motorizing cane transport.** G. S. BARTLETT. *The Condenser*, 1960, **4**, (3), 43–45.—An account is given of the manner in which the problem, raised by the reduction of rail facilities in 1955, of mechanizing cane transport has been met at the Tongaat estate under the somewhat severe conditions imposed by steep and broken land.

* * *

**The Sugar Cane Selection Station of Réunion.** H. MOURGUET. *J. Agric. trop. Bot. appl.* 1959, **6**, 637–652; through *Plant Breeding Abstracts*, 1961, **31**, 695.—In this detailed account of selection and hybridization methods used at the Station, mention is made of some of the most recent varieties produced. R 331, itself derived from a cross between Uba-Marot and POJ 36, has been crossed with the standard variety POJ 2878. Among the hybrids thus obtained were R 445 and R 447; both are now widely grown in the island, having largely replaced R 397 which proved susceptible to gummosis.

* * *

**Selection in bunch and single planted sugar cane seedling nurseries at Louisiana State University.** E. R. BARRETT. *Diss. Abstr.*, 1960, **20**, *LC card Mic* 59-5507, 2482–83, (abst.); through *Plant Breeding Abstracts*, 1961, **31**, 696.—A study was made of the Brix value and other characters of (1) selections in stubble stools of the CP 1955 series of crosses planted as single plants and bunches of 10 and (2) clones established from the selections. It was concluded that the two methods of selection would be equally effective as regards Brix and stalk diameter, weight and height. Selection for Brix was not completely effective. If Brix is therefore not used as a criterion in selection, a much larger number of seedlings may be handled with the same facilities. A larger number of clonal plots should however be established from stubble selections so as to permit further testing of a greater number of seedlings. Selection of Brix in 3-ft clonal plots would be effective for isolating high-sucrose canes. Data on selections in stubble stools of the CP 1956 series of crosses also revealed little difference in the Brix of canes from the bunch and single-plant methods of selection. Survival studies of seedlings in the greenhouse indicated that a high percentage of bunched seedlings are eliminated at random before becoming established in the field. "Field studies also indicate that more than one cane per hill could be selected from plant cane seedlings without obtaining two canes of the same variety at a high frequency. However, selection of more than one per hill in stubble would greatly increase the possibilities of selecting two canes of the same variety."

* * *

**The ageing of sugar cane clones.** V. TRIPPI and E. R. MONTALDI. *Phyton, Vicente López*, 1960, **14**, 79–91; through *Plant Breeding Abstracts*, 1961, **31**, 697.—Clonal propagation of flowering plants may be effected by means of cuttings either from vegetative parts which are sexually immature, such as basal shoots, or from parts which are sexually mature and are about to flower or have already flowered. In the former case the clone is physiologically young and, it is thought, will go through a juvenile phase with low yields and then a period of high yields before finally undergoing senile decay; in the latter case ageing will take place quickly. To delay ageing in sugar cane it is recommended that basal setts be used instead of the usual apical setts. It is further noted that breeders tend to select individuals which give high yields immediately, i.e. which are physiologically precocious; this has the disadvantage that the period of high yield will be followed rapidly by that of degeneration.

* * *

**Field practices of sugar cane culture in Taiwan.** WAN-CHUN HSU. *Taiwan Sugar*, 1960, **7**, (7), 13–29.—This comprehensive article deals with cultural practices at all stages from land preparation to harvest and, in conclusion, sums these up in a cultural calendar.

[1] *I.S.J.*, 1961, **63**, 136.

# STRUCTURE OF COAGULATED COLLOIDS OF SUGAR BEET JUICE

## (II) Structure of Mud Aggregates in Instantaneous and Progressive Predefecation

By RUDOLF KOHN and ZORA KOHNOVÁ

(Czechoslovak Academy of Sciences, Chemical Institute, Slovak Academy of Sciences Bratislava, Czechoslovakia)

IN our preceding paper[1] we showed that hydrated mud particles of progressively predefecated juice are anisometric, of markedly elongated shape. They may resemble sticks, fibres or elongated rotating ellipsoids. They form a loose structure of a very low volume concentration of particles ($\phi$=0·012). It is necessary to find out whether this space structure is formed chiefly by a mechanical knitting of particles or their aggregation caused by adhesive forces.

The methods of colloido-chemical analysis described in our preceding study[1] enable us to determine the total volume of primary mud particles together with their hydrate envelopes as well as their shape. We can, therefore, with the help of this method experimentally ascertain the validity of DĚDEK's[2] assumptions concerning the course of coagulation of sugar beet juice colloids by an instantaneous and progressive addition of $Ca(OH)_2$, as well as assumptions of the so-called stabilization of colloids[2,3].

DĚDEK[3] looks upon colloids of sugar beet juice as natural ion-exchangers of polyanionic nature on the mixed $K^+$, $Na^+$ and $H^+$ cycle. During defecation of sugar beet juice by calcium hydroxide an exchange of these ions for $Ca^{2+}$ ions occurs. Ion-exchangers, synthetic as well as natural (for instance, beet pulp, peat and the like), are at all times less hydrated on the $Ca^{2+}$ cycle than on $Na^+$ or $K^+$ cycle.

In instantaneous predefecation a sufficiently high concentration of $Ca^{2+}$ ions in the solution is reached all at once. As a result of this there occurs an immediate ion-exchange on the surface of the colloidal particles; i.e. coagulation of colloids. Anions of the surface layer of a colloidal particle bind the $Ca^{2+}$ ions; in this way a surface film with a smaller degree of hydration is formed, which then prevents a further penetration of $Ca^{2+}$ ions to anion groups situated inside the colloidal particle. The ion-exchange takes place imperfectly.

In the case of progressive predefecation, on the other hand, the concentration of $Ca^{2+}$ ions in the solution increases but slowly. At their low concentration in the first phase of predefecation there occurs therefore a gradual ion-exchange in the whole substance of a colloidal particle without the occurrence of coagulation of colloids. Their coagulation occurs only when a higher concentration of $Ca^{2+}$ ions is reached. The ion-exchange is here complete.

On the basis of this different ion-exchange DĚDEK presupposes a different degree of hydration of colloids coagulated by an instantaneous and progressive addition of $Ca(OH)_2$. Colloids which are coagulated in the case of progressive predefecation will therefore be substantially less hydrated than the colloids coagulated by the instantaneous addition of $Ca(OH)_2$. It is in this way that DĚDEK explains the so-called stabilization of colloids of sugar beet juice in the course of their coagulation and the favourable effect of progressive alkalinity rise during predefecation on the filtering and sedimentation properties of coagulated colloids.

The aim of the present work is to determine the total volume and shape of hydrated mud particles and to study their mutual bonds and structure of aggregates both in the case of juice predefecated instantaneously as well as in the case of juice predefecated by a progressive addition of $Ca(OH)_2$.

### EXPERIMENTAL

The diffusion juice was prepared in a DdS-type laboratory diffuser. The temperature during the diffusion was on purpose kept higher than usual so that the diffusion juice might contain a higher than normal concentration of colloid substances, especially pectic substances.

The analysis of the diffusion juice was carried out in the same way as described previously[1,4].

Predefecation was carried out at 80°C by a lime sucrate solution containing 15g sucrose and about 2·3g CaO in 100 ml. The time of progressive predefecation was 10 minutes. In the instantaneous predefecation the juice was kept at 80°C, after the addition of lime sucrate solution, for the same period as the progressive predefecation itself in a parallel sample.

The colloido-chemical analysis was carried out at laboratory temperature by methods described in our preceding study[1]. The total volume of hydrated mud particles and their shape were determined by a com-

[1] *I.S.J.*, 1961, **63**, 79, 10o.
[2] *Sucr. Belge*, 1949/50, **63**, 73; *I.S.J.*, 1951, **53**, 288.
[3] BRIEGHEL-MÜLLER: *Proc. IX. Congr. Ind. Agr.* (Rome), 1952, 4.
[4] KOHN *et al.*: *Chem. Zvesti*, 1958, **12**, 163.

bination of the indicator method[1,5] and the conductimetric method[1,6,7].

For the measurement of viscosity we made use of the Ubbelohde viscosimeter of various capillary widths.

Rheological measurements were made with the help of a rotating viscometer—Epprecht Viscorator type STK with nine acceleration gradients $D$ from 27 to 532 sec.$^{-1}$, rotating body type A. The apparatus was calibrated with glycerol solutions.

For further details see Part I[1].

## Results and Discussion

### *Determination of total volume and shape of hydrated mud particles in the instantaneously and progressively predefecated juice*

The analysis of the primary diffusion juices is given in Table I. The diffusion juice was predefecated in parallel both by the progressive and by the instantaneous addition of lime sucrate solution. Predefecation was carried out in such a way that alkalinity of clear juice was only a little higher than the optimum alkalinity of colloid coagulation of sugar beet juice. By this means we prevent the undesirable peptization of coagulated colloids, which may occur in the case of higher alkalinity in the instantaneously predefecated juice.

**Table I**

| *Sample* | *A* | *B* |
|---|---|---|
| refractometric solids (°Bx) | 15·4 | 15·1 |
| purity (Q) | 87·6 | 87·8 |
| acidity (—% CaO) | 0·024 | 0·023 |
| pH | 6·13 | 6·35 |
| colloids $K/100P$ (g) | 2·82 | 3·22 |
| $N_c/100\ P$ (g) | 0·526 | 0·546 |
| $N_k/100\ P$ (g) | 0·075 | 0·061 |
| polygalacturonic acid/100 ml (g) | 0·108 | 0·168 |

The results of colloido-chemical analysis are given in Table II. The progressive predefecation is marked by the symbol *D-V*, the instaneous predefecation by the symbol *J*. $V_i$ means the true total volume of mud particles together with their hydrate envelopes and $V_c$ the apparent total volume of hydrated mud particles determined by the conductimetric method, on the assumption that the mud particles are in the shape of a sphere (factor $X=2$). Factor $X$ is the parameter characterizing the shape of the particles (see [1,6]).

The true total volume of hydrated mud particles of the coagulate ($V_i$) of the juice which had been predefecated instantaneously and progressively is *practically the same for both methods of predefecation.* In the case of instantaneous predefecation the values of $V_i$ were found to be 1·5 to 2% higher than in the juice predefecated progressively, but this small difference lies within the limits of experimental errors as is shown by the results in Table II. Similar results were obtained in the apparent total volume of hydrated mud particles $V_c$, determined by the conductimetric method (for $X=2$). The ratio of values $V_c:V_i$ is constant for the given sample and independent of the defecation method.

**Table II**

| *Sample* | *A* | | | *B* | | |
|---|---|---|---|---|---|---|
| method of defecation | *D-V* | *J* | Δ% | *D-V* | *J* | Δ% |
| alkalinity of clear predefecated juice ... %CaO | 0·113 | 0·094 | — | 0·137 | 0·130 | — |
| pH | 11·4 | 11·2 | — | 11·4 | 11·4 | — |
| $V_i$ ... vol. % | 0·395 | 0·401 | +1·5 | 0·400 | 0·408 | +2·0 |
| | (±0·001) | (±0·008) | — | (±0·013) | (±0·008) | — |
| $V_c$ ... vol. % | 0·660 | 0·666 | +0·9 | 0·603 | 0·615 | +2·0 |
| | (±0·008) | (±0·014) | — | (±0·012) | (±0·001) | — |
| $V_c:V_i$ | 1·67 | 1·66 | —0·6 | 1·51 | 1·51 | 0·0 |
| factor $X$ | 0·660 | 0·665 | +0·8 | 0·790 | 0·795 | +0·6 |

In our preceding study we have proved that the hydrated mud particles of progressively predefecated juice are of markedly anisometric shape. As we have mentioned in the introduction they may resemble sticks, fibres or considerably elongated rotating ellipsoids. The measure of asymmetry is the factor $X$, which characterizes on the average the shape of the particles of the whole hetero-dispersed system. The low values of factor $X$ which we find from experimental data prove that the particles are markedly anisometric. Factor $X$ (Table II) is equally independent of the defecation method; for the given sample it is constant. From this it is seen that the shape of primary hydrated mud particles is the same for both methods of defecation. (By the term "primary particles" we mean particles without any "imbibition of liquid"; particles from which aggregates are formed.)

From the above mentioned results we can come to this conclusion: *The total volume of primary hydrated mud particles of coagulated colloids of sugar beet juice and their shape do not depend on the method of predefecation but solely on the composition of the primary diffusion juice.* Their total volume and shape are the same whether we coagulate colloids of sugar beet juice by the instantaneous or progressive addition of $Ca(OH)_2$. As follows from the principles of the methods used, it is impossible from these results to come to any conclusion on the size of the primary particles.

In the colloido-chemical analysis described above we did not determine directly the amount of hydrate envelope water of the particles. If a different hydration of mud particles results from a different method of predefecation, it follows from the given results that this hydration is so small that its change is

[5] Kohn: *Chem. Zvesti*, 1961, **15**, 81.
[6] Fricke: *Phys. Rev.*, 1924, **24**, sec. ser., 575.
[7] Fricke and Morse: *Phys. Rev.*, 1925, **25**, sec. ser., 361.

**Table III**

| Sample | A | | | B | | |
|---|---|---|---|---|---|---|
| method of defecation | *D-V* | *J* | Δ% | *D-V* | *J* | Δ% |
| sediment after 24 hours ..... vol. % | 28 | 46 | +64 | 28 | 42 | +50 |
| sediment after centrifugation: | | | | | | |
| $a = 110g$ ..... vol. % | 7·8 | 13·9 | +78 | 6·6 | 11·4 | +73 |
| $a = 720g$ ..... vol. % | 6·2 | 8·6 | +39 | 4·5 | 7·0 | +56 |
| $a = 18800g$ ..... vol. % | 1·93 | 2·27 | +18 | 1·94 | 2·13 | +10 |
| sediment volume of spheres in free sedimentation vol. % | 0·694 | 0·703 | — | 0·701 | 0·715 | — |
| true total volume of hydrated mud particles...vol % | 0·395 | 0·401 | +1·5 | 0·400 | 0·408 | +2 |

**Table IV**

| Sample | | C | | D | |
|---|---|---|---|---|---|
| *Diffusion Juice*— | | | | | |
| refractometric solids | °Bx | 15·6 | | 13·8 | |
| purity | Q | 88·1 | | — | |
| acidity | —% CaO | 0·024 | | 0·026 | |
| colloids $K/100\,P$ | g | 2·01 | | 2·42 | |
| $N_e/100\,P$ | g | 0·563 | | 0·565 | |
| $N_k/100\,P$ | g | 0·055 | | 00·68 | |
| polygalacturonic acid/100 ml | g | 0·074 | | 0·128 | |
| *Predefecation*— | | | | | |
| method | | *D-V* | *J* | *D-V* | *J* |
| temperature | °C | 80 | 80 | 80 | 80 |
| time | min. | 15 | — | 15 | — |
| *Predefecated Juice*— | | | | | |
| alkalinity of clear juice | %CaO | 0·130 | 0·121 | 0·136 | 0·125 |
| pH | | 11·4 | 11·4 | 11·5 | 11·5 |
| sediment after 24 hours | vol. % | 27 | 47 | 24 | 42 |
| sediment after centrifugation at 700 *g* | vol. % | 4·1 | 9·5 | 4·3 | 11·4 |

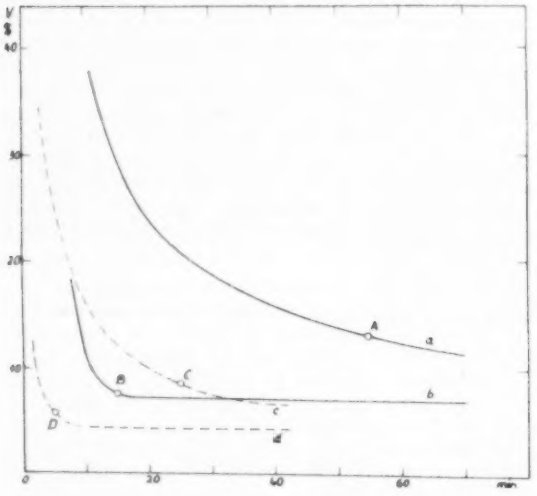



Fig. 1.

Sedimentation of predefecated juice in centrifugation.

Abscissae : time of centrifugation in minutes

Ordinates : volume of sediment *V*, vol. %

*a* = instantaneous predefecation, $a = 110\,g$,
*b* = progressive predefecation, *D-V*, $a = 110\,g$,
*c* = instantaneous predefecation, $a = 720\,g$,
*d* = progressive predefecation, *D-V*, $a = 720\,g$.

Points *A*, *B*, *C*, *D* characterize the moment at which the sediment is compacted.

apparent only within the limits of experimental errors in the determination of the total volume of hydrated mud particles.

These remarks are in agreement with the results obtained by TIBENSKÝ[8], who pointed out that in the case of instantaneous and progressive predefecation there is no practical difference in ion-exchange which occurs during the coagulation of colloids of sugar beet juice caused by $Ca(OH)_2$ addition.

The above-mentioned results together with the conclusions reached by TIBENSKÝ are not in agreement with DĚDEK's assumption[2] which ascribes the different properties of coagulated colloids of sugar beet juice precipitated by the instantaneous and progressive addition of $Ca(OH)_2$ to their different hydration, caused by a different exchange of ions in the coagulation of colloids.

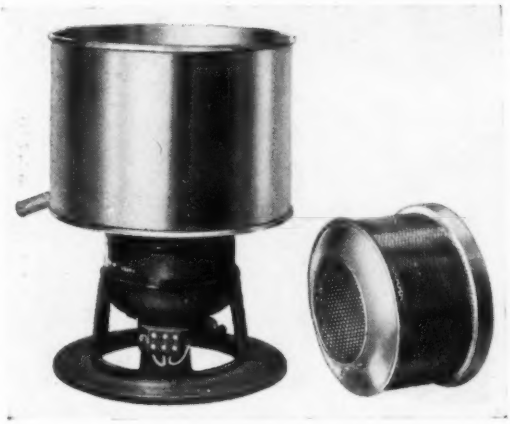
## STRUCTURE OF MUD AGGREGATES

### *Sedimentation of mud particles under gravity and centrifugal force*

The sedimentation of mud particles in centrifugation was observed at different centrifugal accelerations and the measurements given in Table III. The centrifugal acceleration *a* is given in multiples of gravitational acceleration *g*. The sediment volume in centrifugation, as given in Table III, represents the final constant volume of mud, which at the given acceleration does

[8] *Koagulácia v repnej šťave*. Dissertation. Chemicky ústav SAV (Bratislava, 1959); *Listy cukr.*, 1961, **77**, 36-39.
[9] HRUBÍŠEK: *Kolloid Beihefte*, 1941, **53**, 385.

# MASSECUITE EXAMINATION



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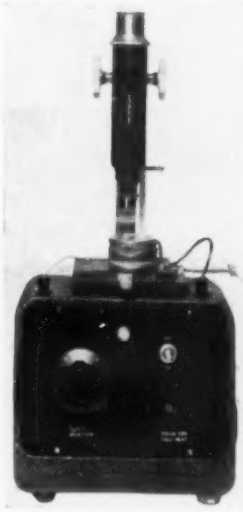

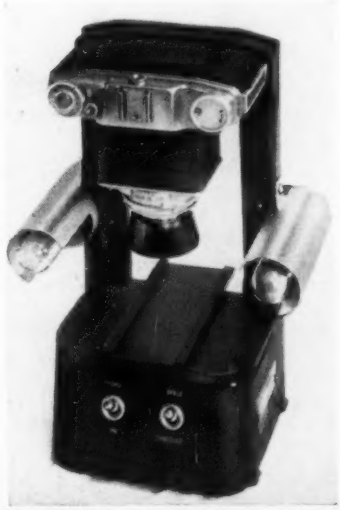

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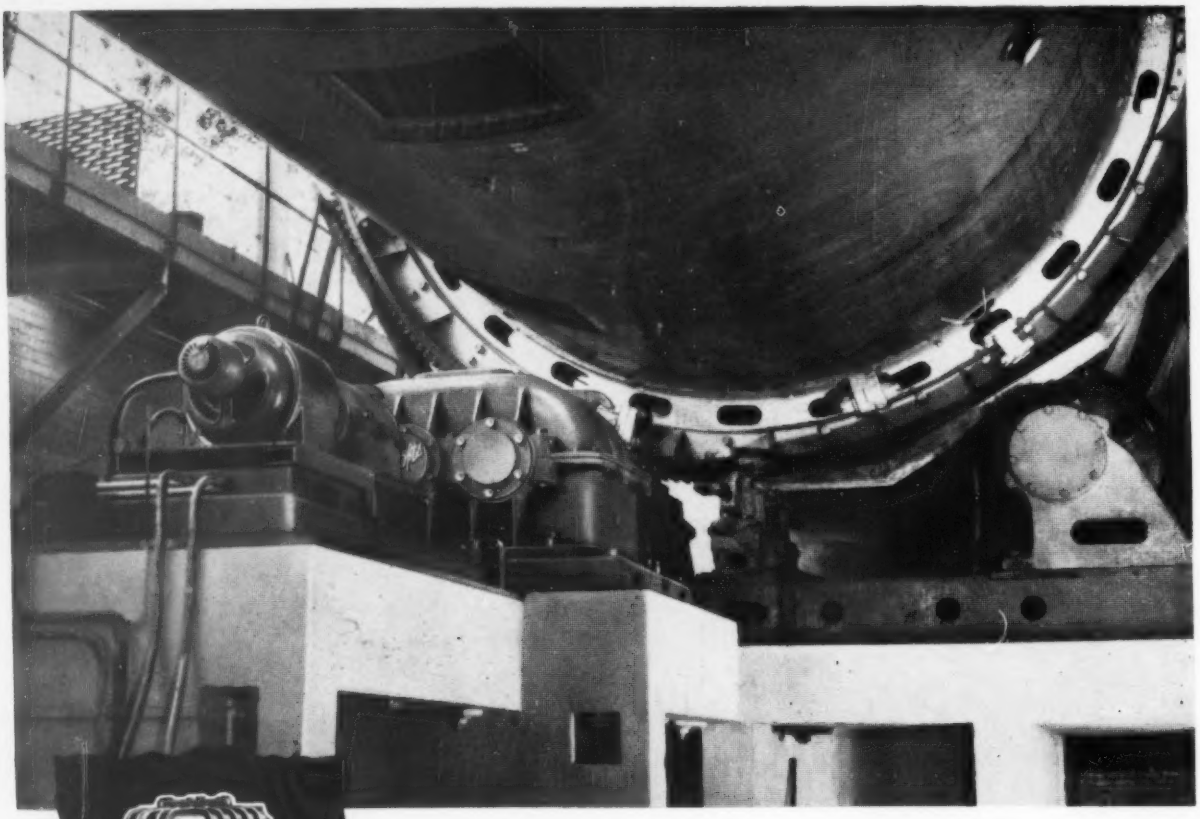

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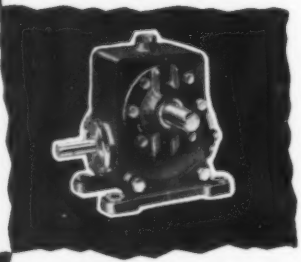

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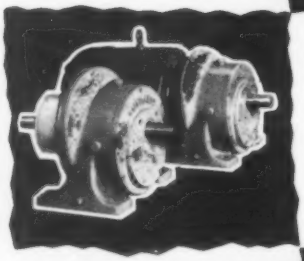

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not change with the period of centrifugation. The sediment of the instantaneously predefecated juice is after 24 hours 64% (*A*) and 50% (*B*) greater than in the case of juice progressively predefecated. At a centrifugal acceleration of 110 *g* the constant mud volume of juice predefecated instantaneously is 78% (*A*) and 73% (*B*) greater than the mud volume of the progressively predefecated juice. This difference decreases with the increasing centrifugal acceleration and when $a=18{,}800$ *g* it reaches only 18% (*A*) and 10% (*B*).

Still greater differences of sediment volume were obtained in instantaneously and progressively predefecated juice in the centrifugation of mud suspensions at 700 *g* recorded in Table IV. Sediments under gravity differ by 75% (*C*, *D*), while sediments of mud in centrifugation differ by 132% (*C*) and 165% (*D*).

Table III is completed by calculated values of such sediment volume as would be taken up by spheres in their free sedimentation in the field of gravity. Our calculations are based on the assumption that the total volume of spheres in the suspension is equal to the total volume of hydrated mud particles of predefecated juice[6].

The course of sedimentation was followed especially with regard to time in both suspensions (sample *A*) under centrifugal acceleration of 110 *g* and 720 *g*. The results are illustrated in Fig. 1. In the case of mud centrifugation of progressively predefecated juice a constant volume of sediment is reached in a comparatively short time (curve *b*, $a=110$ *g*; curve *d*, $a=720$ *g*). The sedimentation of mud of instantaneously predefecated juice takes place very slowly in centrifugation (curve *a*, $a=110$ *g*; curve *c*, $a=720$ *g*).

*(To be continued)*

# THE RELATIONSHIP BETWEEN FILTRABILITY AND FILTRATION-IMPEDING IMPURITIES

By R. I. NICHOLSON, PETER HIDI and GWYNNETH McINTYRE

(Research Department, The Colonial Sugar Refining Company Ltd., Sydney, Australia.)

## Introduction

THE problem of slow-filtering, impure sugar syrups has been the subject of many investigations throughout the industry[1,2,3,4,5]. Numerous filtrability tests have been described which have yielded qualitative results, difficult to interpret and not amenable to quantitative treatment.

The present paper describes a relationship between a filtrability test and the activity of filtration-impeding impurities. This relationship has permitted the study of a number of factors which affect filtration rates and generally permitted a better understanding of the problem of slow filtrability.

## Theory and Discussion

Using the filtrability test described by Nicholson and Horsley[6], it has been found that the logarithm of the filtrability of an impure sugar/pure sugar mixture is linearly related to the proportion of impure sugar in the mixture over the range 0% to 100% impure sugar. This relationship applies to all the raw sugars (from widely differing origins) that we examined, as well as to other impure sugar products such as liquors, syrups, and B and C sugars. Some of the experimental results are shown in Fig. 1.

This empirical relationship may be most simply expressed as

$$-\log \frac{F}{100} = kc = A \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

In equation (1) $F$ is filtrability per cent expressed as 100 times the ratio of the filtration rate of the test

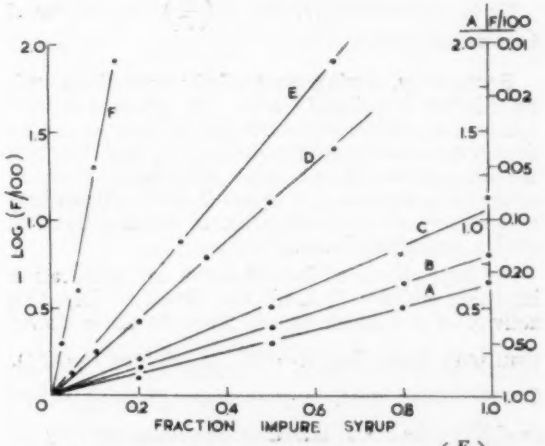



Fig. 1.—Natural sugar impurities. Plot of $-\log\left(\frac{F}{100}\right)$ versus fractions of impure sugar product. Curves A, B and C are raw sugars of filtrability decreasing from A to C. Curve D is a "C" sugar and E and F are syrups.

[1] Kortschak: *I.S.J.*, 1953, **55**, 163.
[2] Balch: *Ind. Eng. Chem.*, 1957, **49**, 904; *I.S.J.*, 1958, **60**, 78.
[3] Alexander: *Proc. 31st Congr. S. African Sugar Tech. Assoc.*, 1957, 68; *I.S.J.*, 1959, **61**, 115.
[4] Alexander: *S. African Sugar J.*, 1958, **42**, 579; *I.S.J.*, 1959, **61**, 116.
[5] Wells: *Tech. Report* (Sugar Research Inst., Queensland), 1960, (58); *I.S.J.*, 1960, 62, 261.
[6] *Proc. 9th Congr., I.S.S.C.T.*, 1956, (2), 271; *I.S.J.*, 1957, **59**, 105.

sugar to the rate of pure sugar under identical conditions; $c$ is the concentration of the impurities which impede filtration and $k$ is the activity or performance coefficient of these impurities emphasizing that filtrability, as will be seen later, is dependent not only on their concentration, but also on their quality, which includes such factors as size, size distribution, shape, deformability, etc.

With natural sugar syrups, because of the complexity of the impurities, we cannot accurately measure $k$ and $c$ separately, but we deal with their product, i.e. the filtration-impeding activity ($A$).

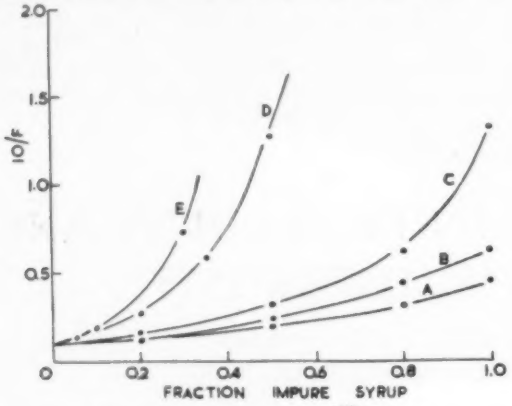



Fig. 2.—Data as in Fig. 1. Plot of $\left(\frac{10}{F}\right)$ versus fraction of impure sugar product.

Fortunately, during most of the operations such as dilution mentioned earlier, or others described below, the performance coefficient of these impurities does not appear to change significantly and therefore we can look on ($A$) as a linear proportional function of the concentration and regard it in the calculations as a hypothetical concentration of the filtration impeding impurities (F.I.I.).

We have chosen arbitrarily as the unit of filtration impeding activity (F.I.A.) the filtration impeding activity of a solution which filters 10 times slower than pure sugar (i.e., $A=1$ if $\frac{F}{100}=0{\cdot}1$ or $F=10\%$). On the other hand, a pure sugar gives $\frac{F}{100}=1$ or $F=100\%$; i.e., no filtration impeding activity is present and $A=0$.

Fixing these two points resulted in the simple relationship between filtration impeding activity and filtrability expressed in Equation (1).

The use of this relationship to the different procedures during sugar manufacture is discussed in the application section of this paper.

With artificial filtration impeders, the logarithmic relation fails but a plot of $\frac{1}{F}$ ($\frac{10}{F}$ for a convenient scale) is found to be linear with corresponding dilutions of filtration impeders. This relationship applies particularly when the added filtration impeder is a non-deformable solid (Fig. 3B).

Figs. 1, 2 and 3A, 3B, compare the filtrabilities of natural and synthetic impurities plotted as logarithmic and reciprocal functions showing clearly the difference in behaviour of the natural and synthetic impurity groups. The slopes of the plots in the figures indicate the different levels of filtration-impeding activity and

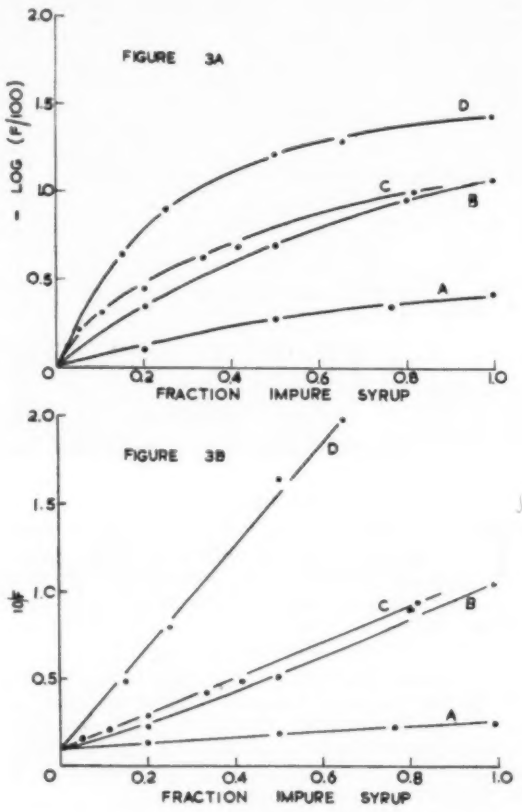


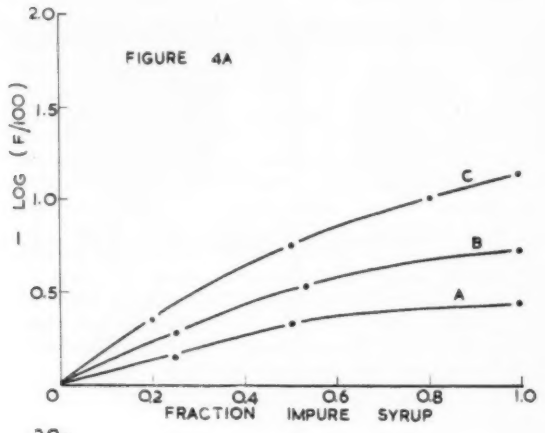

Fig. 3A.—Artificial impurities added to pure syrup. Plot of $-\log\left(\frac{F}{100}\right)$ versus fraction of impurity. A is calcium carbonate, B is calcium phosphate, C is a polyelectrolyte (Dow AP30), D is magnesium phosphate.

Fig. 3B.—Data as in Fig. 3A. Plot of $\left(\frac{10}{F}\right)$ versus fraction of impurity.

the shape of the curve is important to show which relationship is applying. Some of the synthetic impurities, as for example, calcium phosphate-protein mixture, appeared to be intermediate in their properties between natural and most of the synthetic impurities. This is shown in Figs. 4A and 4B where neither method of plotting achieves a linear relation. There is some evidence that certain mixtures of calcium phosphate and protein could give, even at low filtrabilities, linear log plots, i.e. behave in a

similar manner to naturally occurring impurities, but the reproducibility of the conditions has proved too difficult to be certain of the conclusion.

Tests have been made to ascertain if the observed relationship between $-\log F$ and $A$ was influenced by an increasing solubility of the filtration impeding impurities (F.I.I.) as the dilution with pure syrup increased. These were made by repeatedly filtering syrups from sugars until the filtrability reached 100% and then using these syrups as the diluting medium instead of pure syrup. These syrups would be saturated with impurities so that there should be no solution of F.I.I. on dilution. The tests indicated that there was no significant difference between the relationship by diluting with these syrups and that obtained by diluting with pure syrup. Accordingly, it has been assumed that solution of F.I.I. by dilution is not a factor responsible for the observed relationship. It should also be noted that similar results have been obtained with another filter aid (standard "Supercel").



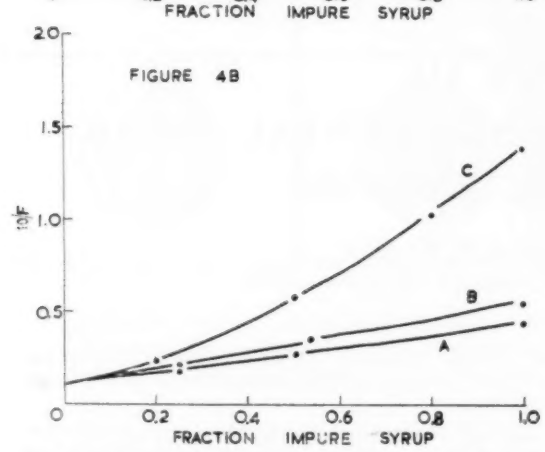




Fig. 4A.—Artificial impurities added to pure syrup. Plot of $-\log\left(\frac{F}{100}\right)$ versus fraction of impurities. A is blood albumen, B is blood albumen plus calcium phosphate (2·7 to 1), C is blood albumen plus calcium phosphate (1·6 to 1).

Fig. 4B.—Data as in Fig. 4A. Plot of $\left(\frac{10}{F}\right)$ versus fraction of impurity.

## Experimental

### *Filtrability Test*

This was carried out according to the method of Nicholson and Horsley[6], with the modifications that a faster paper (Whatman No. 54) was used as the septum and a finer grade of filter aid ("Celite 505") at the rate of 0·55% on the weight of sugar. The Whatman No. 1 paper previously recommended has shown variations in its porosity sufficient to affect the accuracy of the determination.

The mixing of the filter aid, stirring and the time of standing, particularly if the pH of the solution has been adjusted, must be carefully standardized for duplicatable results.

### *Raw Sugars*

The filtrability of most raw sugars lies within the range of the test. The test of their filtrability on dilution is most conveniently made by preparing two solutions at identical Brix (60°) and pH. One solution contains the sugar under test and the other pure sugar or pre-filtered refined sugar. These solutions are mixed so as to contain known fractions of impure sugar.

The filtrability ($F$) of each mixed solution is determined and $-\log\left(\frac{F}{100}\right)$ plotted for each mixture versus its faction of impure sugar.

### *Slow Filtering Materials*

Many mill products are outside the convenient range of the filtrability test but may be diluted with pure sugar or filtered syrup. Recommended dilutions on a solids:solids basis are:

| | | | | | | |
|---|---|---|---|---|---|---|
| "C" sugar | 1 | part | + | pure sugar | 5 | parts |
| liquor | 1 | ,, | + | ,, | 7 | ,, |
| "A" syrup | 1 | ,, | + | ,, | 14 | ,, |
| "B" syrup | 1 | ,, | + | ,, | 28 | ,, |

The filtrabilities are measured at these dilutions, i.e. 6, 8, 15 and 29, and the results for any particular sample used in conjunction with the filtrabilities of further dilutions to demonstrate that $-\log\left(\frac{F}{100}\right)$ is linear with the reciprocals of the dilutions. Alternatively, the filtrability of any known dilution may be used to calculate the filtrability of the original undiluted sample by reading the "$A$" of the diluted sample from Fig. 1, multiplying by the dilution which will give the "$A$" of the undiluted sample and hence its filtrability.

### *Affinations*

A study was made of the distribution of filtration-impeding activities within the raw sugar crystal by stirring the crystal with syrup for 10 minutes in a domestic "Mixmaster" mixer and separating

the massecuite by centrifugation. The quantity of pure 60° Brix syrup added is calculated from the amount of sugar it is desired to dissolve for saturation at the working temperature—usually room temperature. The distribution of activities can be calculated from the weight and filtrability of the original crystal and the weight and filtrability of the affined crystal.

If a balance of activity is to investigated, similar figures are obtained for the syrup after removal of the crystal. It is more convenient to work on separate weighings of crystal and syrup for each degree of affination rather than treat the same crystal with successive syrups.

Table I indicates a convenient procedure.

**Table I**
**Affination of Crystal**

| *Weight of Crystal* | *Weight of 60° Brix Syrup* | *Approx. % Crystal Dissolved* |
|---|---|---|
| Brand 1 Sugar 350 g..... | 195 g | 10–12 |
| 350 g..... | 355 g | 23 |
| 350 g..... | 500 g | 31–33 |
| "C" Sugar 250 g..... | 80 g | 15 |

*Sugar Boiling*

The distribution of filtration impeding activities between crystal and syrup was determined by boiling a number of liquors containing known synthetic impurities.

Certain materials which required little preparation were added direct to the liquor. These included calcium carbonate, potato starch and blood albumen (after suitable dispersion), polyelectrolyte (Dow AP30) and fine incompressible solids such as filter aid (in excess of normal).

Other materials such as calcium and magnesium phosphate were prepared by precipitation, either alone, or mixed or at varying metal:phosphorus ratios. Numerous procedures were tried but only one typical run is described. The syrup of 64° Brix (3000 g) contained 2% KCl, 105 m.mole $Ca^{++}$, 52·5 m.mole P, i.e. a phosphorus content of 850 p.p.m. on sugar. It was prepared by adding 1 M $KH_2PO_4$ and 20% KCl solution to 0·15 M $CaCl_2$ solution. The pH value was adjusted to about 10·5 with NaOH, the solution heated for one hour at 100°C and cooled; a measurement of pH usually showed it to be about 8·8. If after the period of heating the pH had dropped below the desired figure of around pH 8·8, a further adjustment of pH with alkali was made and the solution reheated and checked before sugar was added. (Solutions which contain magnesium as well as calcium do not undergo such a large pH drop on heating.) The pH was finally checked and adjusted to a range of 8·2 to 8·4. The solution was then adjusted to 60° Brix and samples taken for filtrability and for boiling to crystal and syrup.

(*To be continued*)

# A CENTURY OF UTILIZATIONAL AND FUNDAMENTAL WORK ON SUGARCANE BAGASSE

**By V. R. SRINIVASAN and S. R. PATHAK**
**Department of Chemistry, Osmania University, Hyderabad, India**

## PART II

### Pulping for Paper Manufacture

Although many of the conventional chemical processes[9,19,51,52] have been attempted for pulping bagasse, the few outlined below are worthy of mention. These processes can be broadly classified into "Batch pulping" and "Continuous pulping" processes.

*Batch pulping processes*

The acid sulphite process is one of the earliest processes adopted for pulping bagasse. The Tatu mills[53] in Taiwan used an acid magnesium based sulphite process in 1939 for the production of bleached pulp from bagasse. Although their production was interrupted shortly afterwards by war, on resumption of activities later, their output of bleached pulp has touched a new high level of 100 tons per day, making them the biggest manufacturers of bagasse pulp in the world. Presently, however, they have changed over to a neutral sodium sulphite process with soda as buffer.

Though the neutral sulphite process[19,51,54,55] using sodium sulphite with sodium hydroxide or sodium carbonate as a buffer was being used in Germany and Italy only for pulping straw, it has been suggested that it can also be used for bagasse. Sodium carbonate and bicarbonate may also be used in place of sodium hydroxide. A modified sulphite process, patented as the A.Z. process[51] by Aschaffenburger Zellstoffwerke, Redenfleden, West Germany, involves the use of sodium sulphite along with sodium carbonate or sodium bicarbonate, on bagasse which

[51] Ref. 9, pp. 21–24.
[52] Atchison: *Indian Pulp and Paper*, 1955, **9**, 389.
[53] Ref. 2, p. 3.; ref. 9, p. 1.
[54] Ref. 2, p. 12.
[55] Captein *et al.*: *Tappi*, 1957, **40**, (8), 620.

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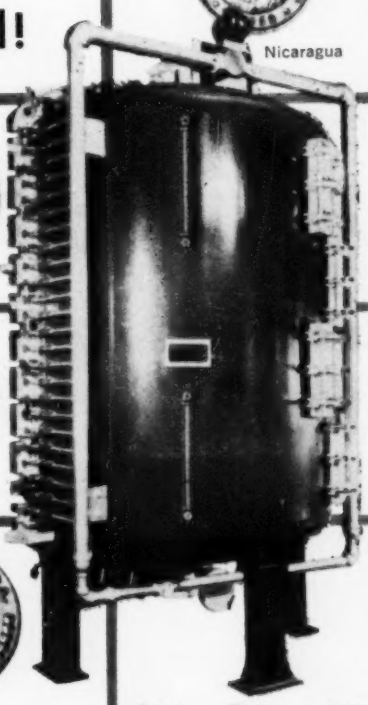

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The soda process[8,19,51,52,56] involves the digestion of the material with alkali either in the cold or at a high temperature and pressure. W. R. Grace & Co., in Peru have been manufacturing pulp from bagasse by a modified soda process[57] since 1939, wherein the use of a small amount of sulphur along with the alkali confers some of the advantages of the sulphate process to this procedure.

In the sulphate or kraft process[8,19,51,52,56,58,59] the material is digested with sodium sulphide and alkali under pressure in digesters. STUCK[48] has patented a modified version of the kraft process, using a two-stage cooking involving the additional use of sodium peroxide, ammonium nitrate, sodium phosphate and sodium hexametaphosphate.

Methods involving the use of dilute nitric acid[19,60–65] for the pulping of bagasse have also been developed. These processes consist of digestion of the caustic soda pre-treated material with dilute nitric acid and then cooking the product with soda. In general pulps obtained by this procedure have lower viscosity than those produced by other processes.

The mechano-chemical process[19,26,51,66] which is based on cooking the material in a hydrapulper at atmospheric pressure, has been developed by LATHROP and ARONOVSKY at the Northern Regional Research Laboratories at Peoria. The temperature and time required for pulping by this process are lower than those for the conventional pressure cooking methods and the yield is higher. Many advantages are claimed for this process.

*Continuous pulping processes*

Though a number of continuous pulping processes used for straws and similar materials are also used for producing unbleached pulp from bagasse, the Celdecor Pomilio continuous soda-chlorine process[51,67] based on the earlier Italian Pomilio process[68], enjoys great popularity since its introduction on a commercial scale in 1941 by Cia. de Celulosa de Filipinas[67]. This process has been developed by the Cellulose Development Corporation, England, and consists of cooking the depithed material with dilute sodium hydroxide solution in a vertical digester followed by chlorination in a vertical tower, washing with dilute alkali and water, screening and finally bleaching. Mills producing bleached pulp from bagasse by this process are operating successfully all over the world. In addition, there are some mills producing unbleached pulp from bagasse by this process in Argentina, Colombia, Mexico, Peru and South Africa. Improvements[69] in the digester system such as the Pandia continuous digester have also helped to overcome the difficulties encountered in the pulping of bagasse.

Generally speaking, all the methods used for pulping straws and similar material have been tried, with or without modification, for pulping of bagasse. In addition, a few novel methods have also been advocated. Thus, RITTER[70] has suggested the use of special cultures, specially adapted for the disintegration of the incrustants of bagasse fibres. HORN[71] has protected an electrolytic method for the pulping of bagasse. VÁZQUEZ[72,73] has also suggested the causticization, by lime, of the ashes obtained from sugarcane trash, leaves, molasses, residues etc., for preparing the alkali needed for the pulping procedure.

LATHROP and ARONOVSKY[19] point out that the pulp obtained by the mechano-chemical process is stronger than that obtained by the Celdecor process. The comparative study by KNAPP[55,56,59,74] of the different conventional methods cited above as well as the modified alkaline and hydrotropic pulping of bagasse, indicates that the soda and kraft processes hold a considerable advantage over the neutral sulphite and acid sulphite processes, except in unusual situations. The modified alkaline cooking or hydrotropic pulping procedures do not appear to offer any special advantages over the standard methods and, in fact, would require special equipment, without an equivalent increase in the pulp yield or strength.

STUDIES ON THE MANUFACTURE OF DISSOLVING PULP

Although patents for the preparation of dissolving pulp and rayon from bagasse cellulose seem to have been taken as far back as 1927, efforts towards the commercial exploitation of these claims have not progressed satisfactorily. Japanese workers have been interested in this angle for a long time. These workers[75–78] observed that pentosans could be easily removed from bagasse by pre-treatment with dilute sulphuric acid or sulphurous acid and that the pulping

[56] KNAPP and WETHERN: *ibid.*, 1957, **40**, (8), 609.
[57] Ref. 2, p. 3.
[58] NOLAN: "The Alkaline Pulping of bagasse for high strength papers and dissolving pulps", F.A.O. ST/ECLA/CONF. 3/L.5.13, 1st October 1954, pp. 5 *et seq.*
[59] HINRICHS *et al.*: *Tappi*, 1957, **40**, (8), 626.
[60] LYNCH and GOSS: *Ind. Eng. Chem.*, 1932, **24**, 1249; *I.S.J.*, 1932, **34**, 482.
[61] PAYNE: *ibid.*, 1934, **26**, 1339.
[62] HACHIHAMA *et al.*: *J. Soc. Chem. Ind. Japan Suppl. Binding*, 1936, **39**, 239; *Chem. Abs.*, 1936, **30**, 8609.
[63] HACHIHAMA and TAKEMURA: *ibid.*, 1937, **40**, 355; *Chem. Abs.*, 1938, **32**, 1449.
[64] ARONOVSKY and LYNCH: *Ind. Eng. Chem.*, 1938, **30**, 790; *I.S.J.*, 1939, **41**, 188.
[65] ARONOVSKY *et al.*: *Paper Ind.*, 1939, **21**, 41–48, 151–155, 335–343; (10), p. 12 in ref. 3.
[66] ATCHISON: *Sugar J.* (La.), 1955, **17**, (8), 20–24; *I.S.J.*, 1955, **57**, 205.
[67] Ref. 2, pp. 4, 12.
[68] POMILIO: *Ind. Eng. Chem.*, 1939, **31**, 657.
[69] ATCHISON: *Indian Pulp and Paper*, 1955, **10**, 27.
[70] U.K.P. 497,960 (December 30, 1938); *Chem. Abs.*, 1939, **33**, 5185.
[71] U.S.P. 1,779,971 (October 28, 1930); 1,780,750 (November 4, 1930); *Chem. Abs.*, 1931, **25**, 205; U.S.P. 2,446,418 (August 3, 1948); *Chem. Abs.*, 1948, **42**, 8474.
[72] *Brasil açuc.*, 1956, **48**, 307; *Chem. Abs.*, 1957, **51**, 7045.
[73] *Bol. Ofic. A.T.A.C.*, 1959, **18**, 617–622, 699–702, 777–788; *I.S.J.*, 1960, **62**, 143.
[74] *Tappi*, 1957, **40**, (8), 634.
[75] HAMAGUTI *et al.*: *J. Soc. Trop. Agric.*, [Taihoku (Taipei) Imp. Univ.], 1939, **11**, 309, *Chem. Abs.*, 1940, **34**, 7136.
[76] *idem. ibid.*, 1940, **12**, 9; *Chem. Abs.*, 1941, **35**, 1988.
[77] HAMAGUCHI *et al.*, *ibid.*, 1941, **13**, 280; *Chem. Abs.*, 1948, **42**, 3175.
[78] *idem.*, *ibid.*, 1942, **14**, 1; *Chem. Abs.*, 1948, **42**, 3175.

of such a bagasse yielded dissolving pulp of a superior quality. TANAKA[79] found that prehydrolysis with water under high temperatures and pressures was quite satisfactory. In all these cases it appears that the ash content of the pulp obtained could not be low enough for the dissolving pulp grade. TADOKORO[80] studied the properties of viscose rayon prepared from a mixture of bagasse pulp, fish protein and urea.

Most of the recent attempts in this direction involve a water or sulphuric acid pre-hydrolysis. HORIO and TAKAHAMA[81] reported that Indian bagasse, even after such a treatment followed by sulphate cooking, does not yield a satisfactory grade of dissolving pulp. However, the recent findings of various investigators[82-86], who worked on at least partially depithed material, appear to be encouraging. MITRA[82] worked out the optimum conditions for acid pre-hydrolysis and sulphate pulping of bagasse. LOCUS[83] after a study of pre-hydrolysis with a variety of reagents has concluded that effective pentosan removal depends on the conditions of hydrolysis, although drastic conditions appear to give only low pulp yields of inferior quality. JAYME and ROSENSTOCK[85] reported that Peruvian depithed bagasse can be pulped by a water pre-hydrolysis, followed by the sulphate process and bleached in a series of stages to yield a rayon-grade pulp of good quality. The bleached pulp which was obtained in a yield of 21% of the dry, whole bagasse had a D.P. of 641. Another investigation by FAHMY and EL ASHMAWY[86] indicates that pulping of bagasse, after a prehydrolysis and subsequent removal of 3% of the pithy residue, yields a pulp of low ash content and an α-cellulose value suitable for dissolving pulp. It is claimed that pulping by this method can be carried out under atmospheric pressure yielding a final product of good filtrability. OKUNO[87] protected a method using acetic acid to remove pentosans and silica, followed by a conventional alkali or kraft cook and bleach for obtaining a rayon-grade pulp from bagasse.

In spite of these findings, bagasse does not appear to be a preferred choice for raw material for dissolving pulp except under somewhat unusual economic conditions, on account of its relatively low percentage of alpha-cellulose and high pentosan content. Nevertheless, bagasse as a source of dissolving pulp is definitely worthy of consideration and greater experimentation in places where conventional cellulosic raw materials are not available in plenty.

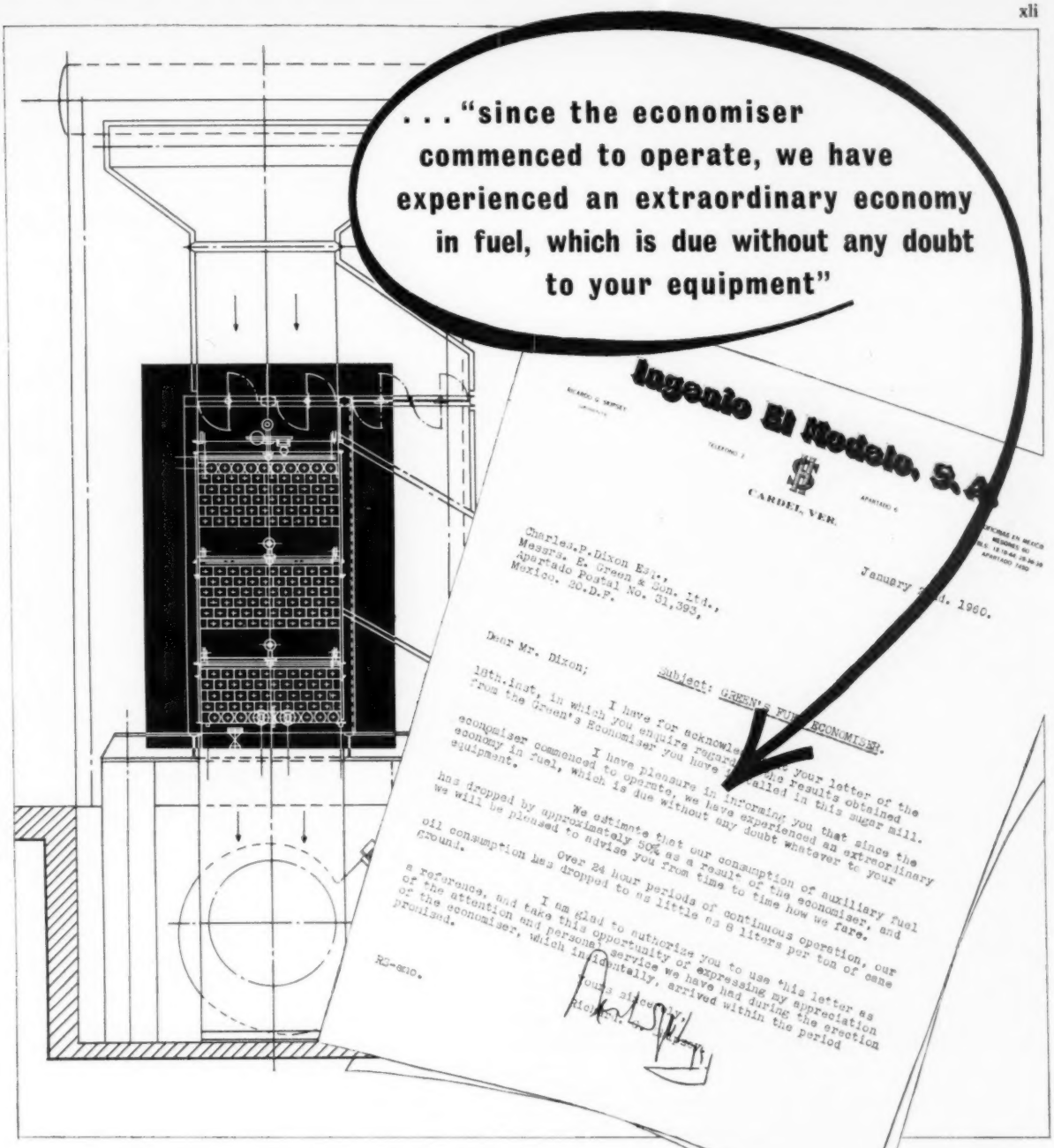
## STUDIES ON THE NON CELLULOSIC POLYSACCHARIDES OF BAGASSE

Apart from investigations on its suitability as a cellulosic raw material, a large amount of work has also been reported on the nature and utilization of the noncellulosic constituents of bagasse. The earliest report on such non-cellulosic materials from bagasse was in 1904 by BROWNE[5], who found that the cane gum obtained from bagasse consists of xylan and araban. FARNELL[88] pointed out that the hemicellulose of bagasse, if at all any was present, was not of the mannan-galactan type. A more comprehensive investigation was reported by HACHIHAMA[89]. The water-soluble pectin hydrate fraction he isolated from sugar cane bagasse resembled that from flax in composition and gave on hydrolysis galacturonic acid. Further fractionation of this pectin hydrate[90] by 70% alcohol yielded an alcohol-soluble hexopentosan and an alcohol-insoluble calcium-magnesium salt of pectic acid in roughly 2·4:1 proportion. The former on hydrolysis gave some resinous matter and a mixture of L-arabinose, D-galactose and D-fructose. The water-insoluble hemicellulose[91] appeared to be of the araban-xylan type, with the xylan part predominating.

HAMAGUTI and co-workers[92,93] fractionated the hot water extract from bagasse and obtained two products; one yielding on hydrolysis, D-galacturonic acid, along with D-galactose and L-arabinose and the other only arabinose. The residue left after hot water treatment, on extraction with ammonium oxalate, yielded an extract giving rise to only D-galacturonic acid on hydrolysis. The hot-water insoluble residue was extracted with different concentrations of sodium hydroxide resulting in two types of hemicelluloses[94]. One consisted of arabinose (8%) and xylose (92%) and the other had, in addition, glucose units also. DAVIS and PHILLIPS[95] obtained D-glucuronic acid, L-arabinose and D-xylose on hydrolysis of the hemicelluloses of sugar cane bagasse. YOSHIHIRO[96] worked out the optimum conditions and the minimum precipitant concentrations for the isolation of the hemicellulose of bagasse and also studied its acetylation. BANERJEE, BOSE and MUKHERJEE[97,98] isolated hemicellulose fractions from the holocellulose prepared from bagasse. They have shown that the fraction obtained by 4% potassium hydroxide consisted of uronic acid and a sugar fraction which has been tentatively identified as comprising of glucose, arabinose, xylose and fructose. However, the exact constitution of the hemicellulose fractions has not been worked out. Detailed studies on the isolation, fractionation and the structure of the various fractions of bagasse hemicelluloses are in progress in the authors' laboratory.

*(To be continued)*

[79] *J. Agric. Chem. Soc. Japan*, 1939, **15**, 25; *Chem. Abs.*, 1940, **34**, 261.
[80] *ibid.*, 1941, **17**, 404; *Chem. Abs.*, 1947, **41**, 4917.
[81] *Bull. Inst. Chem. Research*, (Kyoto Univ.), 1958, **36**, (5), 172; *I.S.J.*, 1959, **61**, 379.
[82] *Tappi*, 1959, **42**, (5), 366; *I.S.J.*, 1960, **62**, 109.
[83] *ibid.*, 1960, **43**, (1), 11.
[84] NAFFZIGER *et al.*: *ibid.*, 1959, **42**, (7), 609.
[85] *Das Papier*, 1957, **11**, (1/2), 7; *Chem. Abs.*, 1957, **51**, 6148.
[86] *Tappi*, 1958, **41**, (8), 439.
[87] Jap. patent 2351 (March 31, 1956); *Chem. Abs.*, 1957, **51**, 7718.
[88] *I.S.J.*, 1923, **25**, 630.
[89] *J. Soc. Chem. Ind. Japan Suppl. Binding*, 1933, **36**, 259; *Chem. Abs.*, 1933, **27**, 4122.
[90] HACHIHAMA and HAYASHI: *ibid.*, 258; *Chem. Abs.*, 1933, **27**, 4122.
[91] HACHIHAMA: *ibid.*, 634; *Chem. Abs.*, 1934, **28**, 926.
[92] *J. Soc. Trop. Agric.* [Taihoku (Taipei) Imp. Univ.], 1938, **10**, 84; *Chem. Abs.*, 1939, **33**, 5218.
[93] *ibid.*, 1939, **11**, 207; *Chem. Abs.*, 1940, **34**, 6472.
[94] *ibid.*, 215; *Chem. Abs.*, 1940, **34**, 6472.
[95] *J. Agric. Research*, 1941, **63**, 241; *I.S.J.*, 1942, **44**, 134.
[96] *J. Chem. Soc. Japan, Ind. Chem. Sect.*, 1951, **54**, 147; *Chem. Abs.*, 1953, **47**, 1383.
[97] *Proc. Indian Sci. Congress*, (1960); *Part III: Abstract Sect. IV, Chemistry*, (396).
[98] Programme and abstracts of symposium on hemicelluloses (1960), Central Research Committee, C.S.I.R. (India).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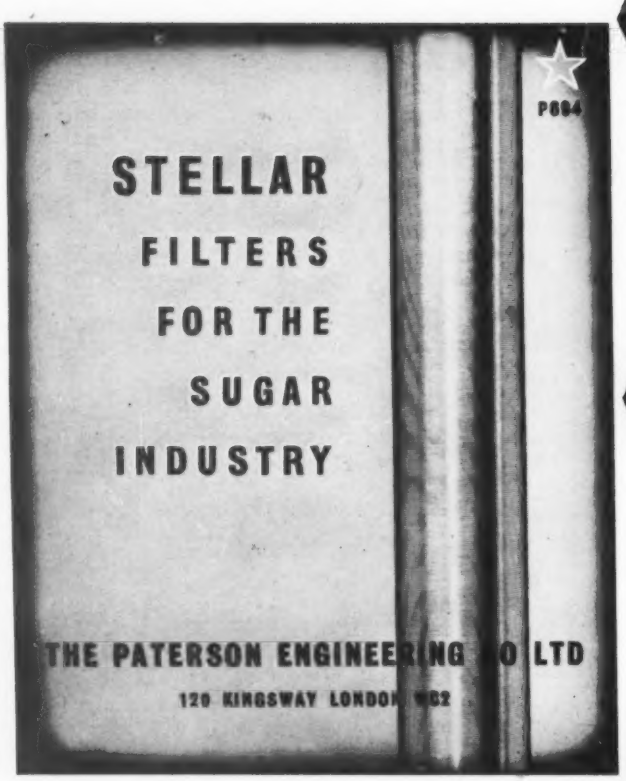


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**Some suggestions for improvement in the working of sugar factories, especially in North-Eastern India.** S. B. DATTA. *Indian Sugar*, 1960, **10**, 465–467.—The suggestions include: employment of a staff of agronomists to advise the cane growers; maintenance of the factory machinery at highest possible efficiency by reliable supervision; quickest possible processing of the raw juice to crystal sugar so as to reduce the risk of fermentation, also overcome by cleanliness and adequate disinfection; highest quality of lime for clarification; adequate staffing and equipping of the factory laboratory; automatic sampling of mixed juice, bagasse and molasses—for the bagasse the equipment should be in duplicate; with very high losses of sugar in molasses the total products should be weighed; determination of sucrose losses due to entrainment and inversion.

* * *

**Increase of milling capacity.** L. A. R. PINTO. *Brasil Açuc.*, 1960, **55**, (5), 14–22.—See *I.S.J.*, 1961, **63**, 82.

* * *

**Excessive production of molasses.** O. ROIG SAUZ. *Bol. Ofic, A.T.A.C.*, 1960, **19**, 425–426.—The opinion that sucrose losses in molasses depend on the amount and nature of non-sugars extracted in milling is quoted and comparative figures calculated for a number of Cuban factories some of which have a high production of molasses and some a low production. In the former, non-sugars extracted % cane vary from 3·11 to 4·10 (average of 1957, 1958 and 1959) while in the latter the variation is between 2·23 and 2·42%.

* * *

**A forward step in the modernization of factory tandems.** U. VILLAR LORENZO. *Bol. Ofic. A.T.A.C.*, 1960, **19**, 417–423, 468–479.—A brief history of the development of motive power for cane mills—human, animal, steam engine, electric and steam turbine, as well as hydraulic—is presented. Advantages of the steam turbine as a mill drive are described, and the single-stage and multi-stage turbines compared and contrasted. A diagram illustrates comparative steam consumption of steam engines and single- and multi-stage turbines as a function of their loading. This shows that steam consumption at full load is higher for an engine than for the single-stage turbine; the reverse is the case at $\frac{3}{4}$-load. A multi-stage turbine is more economical at both $\frac{3}{4}$ and full load, however. Since the turbine develops greater power at smaller steam consumptions, it permits economy of steam at lower loading. Where power required does not exceed 400 h.p. and particularly where only low pressure steam (125 p.s.i.) or no superheat is available, the steam engine is more suitable. For higher powers or where higher pressure and superheated steam is available, steam turbines are more efficient and economical, and in particular the multi-stage type is preferred. The patented Duncan Stewart system of turbine installation is described with reference to its application at Okeelanta sugar factory[1] in Florida, U.S.A., and its advantages are discussed.

* * *

**Theory and practice of raw sugar affination.** E. SCHULZE. *Zuckererzeugung Beilage*, 1960, (2), 1–7.—Raw sugar affination is discussed from the viewpoint of the colour bodies in the products up to affination. Particularly harmful are the polyphenol-iron complex formations which are easily absorbed by the sugar crystals. They are only slightly removed by active carbon, but bone char and kieselguhr are very effective. Caramels and melanoidins are absorbed by the sugar crystals in very small amounts and may be considered harmless. The suitability of a particular raw sugar for affination may be determined by comparing the colour of a laboratory sample of raw sugar melt with that of the white sugar obtained by washing with a given quantity of water. This is demonstrated by a graph and table showing the wash water % raw sugar *vs.* the difference between the melt and white sugar colours. The question of the amount of water to use in the determinations is discussed as is the significance of grain size and crystal form. A table is also given showing the sugar yield, run-off quantity and purity, and difference in the colours of the raw and white sugars at varying wash water percentages.

* * *

**Use of a three-dimension continuous rubber belt conveyor in sugar factories.** G. KLINKENBORG. *Zucker*, 1961, **14**, 15–18.—The "Serpentix" conveyor described consists of belt sections 500–1400 mm wide. The belt sections are reinforced at intervals with vulcanized sections to which is attached a chain. Thus there are two separate belts, one attached to the chain, the other being the belt proper, which is free of any force and may fold to pass around curves of radius down to 3 m. The belt may be tilted and a slope of up to 90° is possible. The conveyor is shown in a number of illustrations as a means of limestone or coal transporting.

* * *

**A simple device for continuous liming and sulphitation.** K. A. JOSHI and O. P. BHARGAVA. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 49–52.—For successful continuous sulphitation it is necessary to have a

[1] *See I.S.J.*, 1961, **63**, 145.

regular supply of juice and $SO_2$. The latter is achieved by use of an Acme burner of 4 sq.ft. tray area per 1000 tons/day cane crushing capacity, together with a 200 c.f.m. air compressor. The reaction tank should have a 30–40 r.p.m. stirrer and should be sufficiently large to allow 15 min retention time. A gas distributor is described and illustrated as well as a lime proportioning device, together with a reaction tank assembly.

* * *

**Mixed juice clarification by the double carbonatation process using superphosphate for final neutralization.** J. M. SAHA, D. L. N. RAO and V. SINGH. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 53–57.—After 2nd carbonatation, final neutralization with $SO_2$ gives no precipitate. If a solution of superphosphate is used instead a pecipitate is obtained. This is removed by filtration and the resulting clear juice contains less colour and ash, CaO removal being 70% on average compared with 5% using $SO_2$ neutralization. Juice purity is higher and a higher yield of better quality sugar is anticipated. Increased costs include that of 0·06% of triple superphosphate on cane, and of an extra heating and filtration; factory trials are necessary to determine whether the advantages outweigh these costs.

* * *

**Vacuum and condensation equipment in sugar factories.** B. N. PANDEY. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 58–63.—See *I.S.J.*, 1961, **63**, 149.

* * *

**Physico-chemical studies on clarification processes. Studies on the solubility of calcium sulphite and calcium lactate in sugar solutions.** N. A. RAMAIAH and J. K. SHARMA. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 64–68.—Saturated solutions of calcium sulphite and lactate were prepared at 50°C using water, 15% sucrose solution, 50 c.c. sucrose solution + 5 c.c. superphosphate solution (previously brought to pH 6·3 with lime), 50 c.c. sucrose + 10 c.c. superphosphate solution, and 50 c.c. sucrose solution + 15 c.c. superphosphate solution. It was found that in both cases the sucrose alone reduced the solubility but the superphosphate increased it again, in the case of calcium sulphite to higher than in water alone by use of 15 c.c. superphosphate. The significance of these results as concerning addition of phosphate to juice as an antiscaling measure is discussed.

* * *

**Effect of triple superphosphate on the composition of evaporator scales.** N. A. RAMAIAH and S. K. D. AGARWAL. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 69–71.—A comparison is made between the composition of evaporator scales deposited in a factory using the Saha-Jain technique and the experimental factory where limed juice was neutralized with $SO_2$. Respective data are: loss on ignition 22·86 and 30·32%, 3·75 and 33·94% silica, 29·1 and 17·37% CaO, 35·5 and 3·49% $SO_3$, nil and 0·28% CuO, nil and 4·73% sesquioxides, nil and 1·2% MgO, nil and 0·97% $P_2O_5$, 9·33 and 1·92% aconitic acid and 2·7 and 2·52% oxalic acid. Reasons for the variations in analysis are advanced.

* * *

**Theory of molasses foundation.** S. B. DATTA. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 91–96.—Some of the literature on molasses formation is reviewed together with the author's original views.

* * *

**Exhaustion of final molasses in factory practice.** V. GURUSWAMY. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 97–100.—Five massecuites were treated in the usual way, i.e. discharged to a water-cooled Werkspoor crystallizer, transferred into a larger Werkspoor crystallizer after a short time (e.g. 4 hr), after cooling passed to a Stevens mingler and reheated to saturation, and finally cured. Samples collected at these points are analysed and molasses purities, etc., tabulated together with the corresponding times and temperatures. Results show the greater dependence of recovery on time of cooling than on temperature. It is recommended that crystallizer retention time should be at least 24 hr while reheating should be as fast as possible to avoid re-solution.

* * *

**Cane kicker.** A. L. BHATIA. *Proc, 28th Conv. Sugar Tech. Assoc. India*, 1960, 142–145.—The kicker described is similar to a set of cane knives but operates at lower speed and in the opposite direction so that excess cane is thrown back along the carrier, filling in gaps and so causing the cane blanket to be level. At Hardoi it was found possible to increase the crushing rate by 21% while the reduced mill extraction was not affected. A 20 h.p. drive is adequate for a crushing rate of 1800–2000 tons/day.

* * *

**Sugar cane milling in India.** G. R. ATHAVALE and S. L. SAXENA. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 146–155.—A brief survey of the milling equipment of Indian sugar factories is given, together with a discussion of their performance in relation to their design and operating techniques.

* * *

**Automatic control of evaporators.** R. C. SHARMA. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 156–163.—A general review of evaporator control is given, including liquid level control, syrup concentration control (by B.P.E. measurement), pressure control (by condenser water regulation), methods of head supply control, and evaporation rate control.

* * *

**Vapour pressure thermometers—their repair, filling and calibration.** R. C. SHARMA. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 164–168.—Detailed practical instructions are provided.

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**Design of process equipment in the sugar industry.** B. N. DAS, S. C. GUPTA and S. C. JOLLY. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 169–173.—In many cases, capacity of process plant in a sugar factory is specified on a basis of the tonnage of cane crushed per hour. Insufficient data are available for determining plant dimensions on the basis of the capacities under defined conditions, and in an attempt to remedy this, an examination is conducted into the performance, i.e. overall heat transfer coefficient at various stages, of a multi-pass tubular juice heater operated at different juice flow rates and initial temperatures, vapour pressure, etc. Some of the inter-relationships are discussed, as are factors to be considered in juice heater design.

* * *

**Performance of juice heaters in cane sugar factories.** I. A. C. RAHA. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 174–178.—Heat transfer in a juice heater is discussed and a linear relation developed between the reciprocal heat transfer coefficient and juice velocity. The significance of this in connexion with juice heater design and performance is discussed with reference to equipment at a number of factories.

* * *

**Some observations in sugar manufacture.** S. L. PHANSALKAR, H. C. BHATTACHARYA and J. K. P. AGARWAL. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 179–181.—From stock figures collected at a factory it seemed likely that low recovery was associated with prolonged retention of a large stock of sugar in the sugar house. Measures were taken to reduce the latter and a corresponding rise in recovery was found.

* * *

**Reduction of sugar losses in molasses. I. General. II. A new pan control instrument.** S. L. PHANSALKAR and H. C. BHATTACHARYA. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 182–184; 185–188.

I. A miniature Nutsch filter, having a capacity of 1 kg of massecuite, is illustrated. It has been used in place of a laboratory centrifuge for examining the degree of exhaustion in vacuum pans during boiling. A number of factors to be studied in this connexion are mentioned.

II. A sampling device for attaching to a pan is described and illustrated. It consists of a frustro-conical sectioned pot with a flange at its wider end by means of which the pot is held into the pan. In one side is a slot. Inside the pot fits a similar conical hollow rotor with a corresponding slot. The inside of the rotor is divided in two by a partition of centrifugal screen material while its base is provided with openings corresponding to other openings in a base plate bolted to the pot flange and holding the rotor inside the pot. A central hole in the base plate, fitted with a hard rubber sealing ring, allows the shaft of the rotor to protrude so that it can be turned by means of a handle. In operation the rotor is turned so that the slots are aligned whereupon the massecuite enters the hollow rotor on one side of the partition. The rotor is turned, sealing the slots from each other, to the point where the openings in its end and the base plate are aligned. Vacuum supplied to the empty side of the partition by way of a molasses collector is aided by air supplied to the massecuite side of the partition, driving molasses through the screen and into the collector. On returning the rotor to the original position, the pan vacuum draws the remaining massecuite back into the body of the pan while steam and air may also be supplied for cleaning out the sampler.

* * *

**The effect of surfactants on the coagulation of colloids in cane juice.** N. A. RAMAIAH, R. D. SRIVASTAVA and K. K. RAO. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 196–200.—Limed and sulphitated juice was heated to 100°C and aliquots added to cylinders containing amounts of a solution of "Fixanol C" (commercial cetyl pyridinium bromide) sufficient to give final concentrations of 0·1 to 0·6%. The rates of settling, pH and supernatant colour were observed in comparison with blank tests; the additive caused no perceptible difference in settling rate or pH, but colour was reduced by increasing the concentration up to 0·2%. Colour was reduced to a decreasing extent over the range 0·2%–0·5% and above 0·5% was higher than in the blank supernatant.

* * *

**Storage of palm gur.** N. GOPINATHAN. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 217–226.—A survey of gur deterioration and storage methods is presented, and it is concluded that the main factors involved are the moisture content and atmospheric humidity, storage temperature, and micro-organisms. Examination of the mechanism of absorption of atmospheric moisture by palm gur shows this to be by capillary flow, and it is concluded that preservation would best be achieved by control of atmospheric humidity; a gur safe having 400 lb capacity is described and illustrated which is designed to this end—it is provided with a quicklime or silica gel desiccant and a kerosene lamp to provide a draught.

* * *

**Continuous vacuum pan.** ANON. *Sakhar. Prom.*, 1960, (12), 49–50.—A continuous vacuum pan designed by V. A. DANIL'TSEV[1] is described. It contains three concentric sections: the outer shell of the pan itself and two inner rotating sections. The syrup is fed into the outer section and the boiled massecuite discharged from the innermost section. A model has been tested on boiling of 1500 tons of 1st and 2nd massecuite. The resultant massecuite quality was no worse than that from batch pans at Gnivan' factory. Some defects have been found, mainly connected with the control instruments. A full-scale pan was to be built and tested in 1960/61.

[1] U.S.S.R. Patent 69,143.

**Drying of beets.** G. S. BENIN. *Izv. Vysshikh Ucheb. Zaved. Pishch. Tekhnol.*, 1960, (1), 23–27.—The literature on beet drying is reviewed with 14 references and reasons given for its non-application in the Soviet Union. In factory tests at Korenovsk in 1959 cossettes were dried in a Büttner drum dryer in March and processed about 4 weeks later in a rotary diffuser. Diffusion was normal, despite the high invert content of the cossettes and their crushed appearance, and total losses of sugar in pulp were 0·3–0·4% on beet compared with 0·6–0·7% with normal cossettes. The raw juice, of up to 23% dry solids, was clarified and filtered without difficulty, the filter-cake thickness being normal. In the factories of the Krasnodar region natural gas should be used for drying and the dried cossettes briquetted with a press of the type used in the building industry.

* * *

**Circulation rate and heat transfer during boiling of highly concentrated sugar solutions.** I. I. SAGAN'. *Izv. Vysshikj Ucheb. Zaved. Pishch. Tekhnol.*, 1960, (5), 103–111.—Results of tests in which highly concentrated sugar solutions were boiled with natural circulation are discussed[1]. It was found as with low concentration solutions that conditions of heat transfer vary with the height of the heating tube and depend on the circulation rate and hydraulic resistances in the tube. The stability of the column of steam, undiluted by the solution, leaving the tube causes the circulation rate to increase with rise in the level of the solution above the heating tube to a maximum rate dependent on the temperature drop and the concentration of the solution, after which it falls. However, this dependence is ambiguous, and one value of the circulation rate corresponds to two different heights of the solution above the tube. The circulation rate also drops with increase in the temperature difference.

* * *

**Purification of 2nd carbonatation juice with bentonites.** V. I. CHOPIK, E. I. ZINGEL' and I. N. TSELOVAL'NIK. *Sakhar. Prom.*, 1960, (12), 11–13.—The use of bentonite as a clarifying agent in many industries other than the sugar industry is discussed and a table given of the chemical composition of Soviet bentonite from two regions of the Ukraine. Factory tests were conducted on 2nd carbonatation juice from damaged beet with a purity of 83·9–87·2. The bentonites were dried at 130°C, then added to the juice (at 85°C) at the rate of 0·2% on weight of juice, either as a single amount or in three doses. After 5 min the bentonite was filtered off. The juice purity rose by an average of 1·1 units, the method of adding the bentonite having no real effect. The juice colour was decreased by 12–20%.

**Determination of the coefficient of mass extraction in a diffuser.** V. M. LYSYANSKII. *Sakhar. Prom.*, 1960, (12), 13–20.—The studies made by a number of authors on the extraction of sugar from cossettes and the functions obtained by solving differential equations are discussed. Factory tests were carried out for determination of the "coefficient of mass extraction" in which the juice, cossettes and pulp were analysed. A formula is derived for determination of the coefficient of slope of the curve of extraction, which is linear over a small section of diffuser. This formula may be used to calculate the mass extraction coefficient from the extraction curve for a diffuser. Tabulated data for 12 cells of a diffuser show that the mass extraction coefficient varies widely, but with a certain regularity throughout the diffuser, and for a continuous diffuser is double that for a battery. The effects of various factors (e.g. cossette size, juice and cossette flow rates, etc.) on the coefficient were examined and the results discussed in detail. Calculation of the coefficient will permit evaluation of different continuous diffusers.

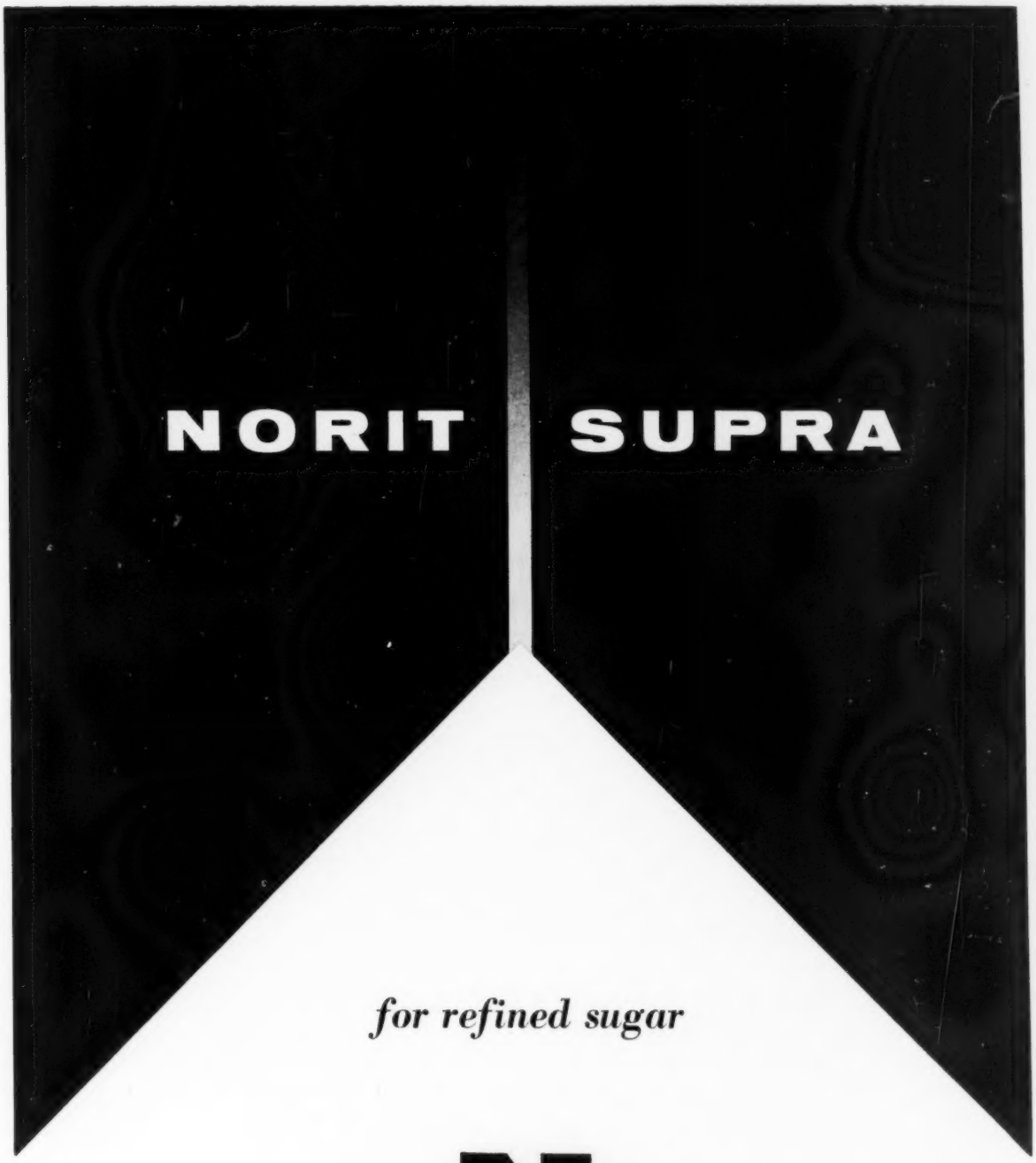
* * *

**Effect of dilution, pH of water and temperature of solutions on the determination of pH of beet factory products.** T. P. KHVALOVSKII. *Sakhar. Prom.*, 1960, (12), 20–22.—The pH of thick juices, massecuites and molasses was measured at various temperatures and degrees of dilution with water of pH 6–8. The values at 40°C differed from those at 20°C by ±0·0–0·2 pH, while they increased sharply with temperature rise to 60°C. pH determination was distorted by considerable dilution, the more so the higher the purity of the product and the greater the difference between the pH of the product and of the water. Lower purity products have a greater buffer action. The dilution water should be of pH 7, deviation from this increasing the error. Dilution should be: 1:2 (v/v) for thick juices, 1:5 for run-offs, and 20–30:100 (w/v) for massecuites.

* * *

**Control of massecuite boiling with a slide rule.** G. A. SOKOLOV, A. K. GOPAK and YA. G. SOKOLOVA. *Sakhar. Prom.*, 1960, (12), 28–34.—A pocket slide-rule designed by G. A. SOKOLOV showing the boiling point *vs.* vacuum also compares the boiling point rise with the values laid down for boiling. The vacuum is the actual pan vacuum corrected from the visual reading. The rule has been used successfully in the control of boiling (nucleation, shock seeding, and massecuite dropping). Values on the rule are compared with the values indicated by vacuum gauge

[1] *See also I.S.J.*, 1960, **62**, 371.

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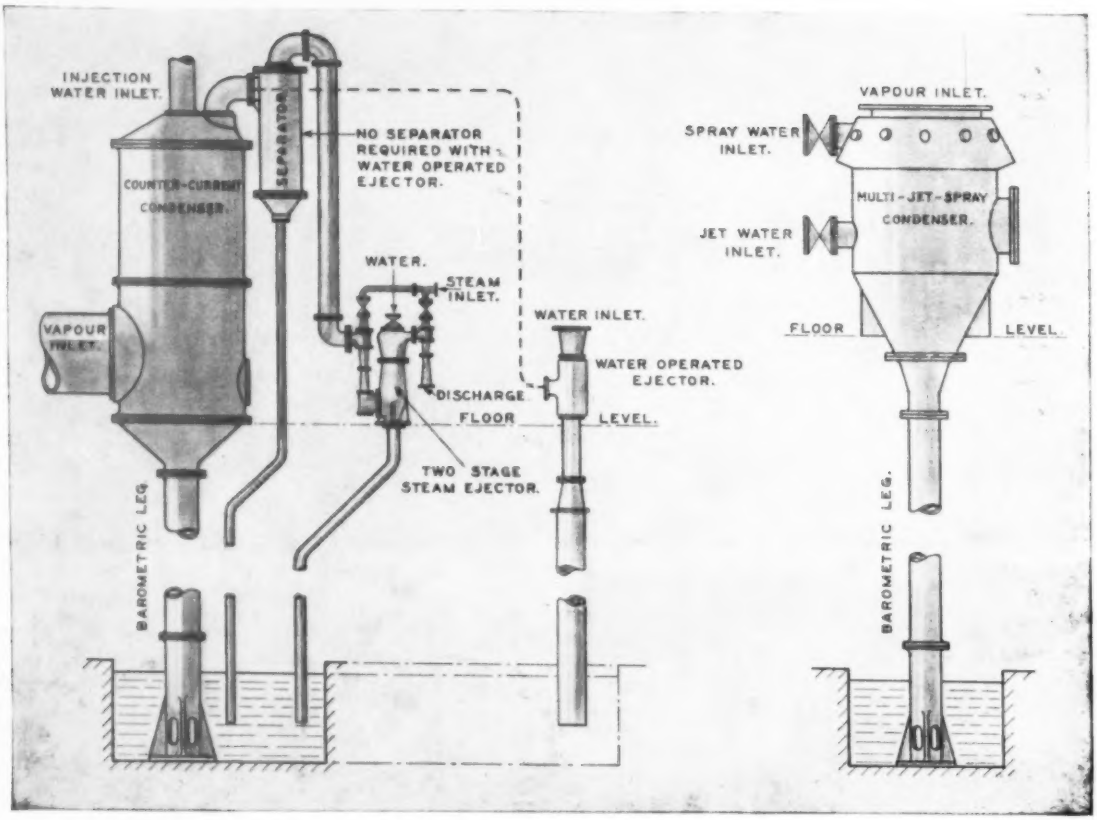


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and thermometer and with the required values at different boiling period for a massecuite of 94·5°Bx and one of 95·3°Bx.

* * *

**Calculation in the (Steffen) separation plant.** L. TARANOVA. *Sakhar. Prom.*, 1960, (12), 35–36.—Formulae are presented which are used for the various balance calculations used at Ertil'sk sugar factory Steffen plant.

* * *

**Determination of the required energy and selection of electric drive for beet slicers.** N. R. FREPON. *Sakhar. Prom.*, 1960, (12), 38–45.—Formulae are derived for calculation of the energy requirements of a beet slicer. The requirements are divided into: power required for actual slicing, for overcoming the friction of the beet against the knives and the knife frames, to accelerate the beet to the slicing speed in a centrifugal slicer, and to overcome the friction between the roots fed from the hopper to the slicer. Finally formulae are given for the total energy requirements of a centrifugal slicer and of a disc-type beet slicer. Formulae are also derived for selection of asynchronous electric motors, based on power consumption and speed, which must correspond to the rotary speed of the slicer shaft at maximum slicing rate.

* * *

**The degree of efficiency of hydrocyclones in separating second carbonatation sludge juice.** O. ASP. *Socker Handl.* II, 1960, **4**, 31–35.—Further experiments were conducted on mud removal from 2nd carbonatation juice, in hydrocyclones[1], in which 0, 100, 200, and 340% sludge was recirculated to 2nd carbonatation. Juice flow to each hydrocyclone was 300 litres/min ± 5% at a pressure drop of 2·5 kg/sq. cm. ± 0·5 kg/sq. cm. A graph drawn of the results indicates a rise of from 50% to almost 90% in the mud removal with increased recirculation; after 200% recirculation the efficiency falls. Sludge concentration in the juice entering the hydrocyclones was 0·12–0·5 weight % and in the returning sludge concentrate 0·8–4·5 weight %. The absolute figures were so low that the fall in clarification efficiency after 200% return cannot be ascribed to the wide variation in the sludge concentration. At 175 and 340% sludge recirculation the respective mud particle sizes were 14 and 23 microns and the efficiencies 87 and 80% respectively. The sludge particle sizes are affected by two opposing factors: (1) acceleration and deceleration in the centrifugal pump and hydrocyclone, which have been found to reduce the size by 27% each time the originally precipitated sludge passes through the system, and (2) the building-up of sludge particles in the 2nd carbonatation tank, which increases particle size by 100% in the 1st recirculation, by 50% in the 2nd and by 33% in the 3rd. Thus particle size increase reaches a maximum at a recirculation of 200% sludge. A mixed-flow pump instead of the usual centrifugal pump might not reduce the particle size so much, although the maximum separation efficiency attainable in a hydrocyclone of reasonable dia. at reasonable pressure drop will be 90% rather than 100%. To attain the latter would necessitate reducing hydrocyclone dia. by half or two-thirds and doubling the pressure drop. Sludge recirculation would then be superfluous. More hydrocyclones would be required if the particle size were increased by adding more lime. The use of filters for 1st carbonatation clear juice and 2nd carbonatation juice which are capable of automation—the Schumacher candle, Philippe TCS and Stellar filters—is discussed.

* * *

**Beet storage in the Soviet Union and the development of new storage methods in the GDR.** H. D. WALLENSTEIN. *Zuckererzeugung*, 1961, **5**, 14–20.—An illustrated report is presented on the practices in the USSR and particularly on the various equipment used. Recommendations based on Soviet experiences are offered for beet storage in East Germany.

* * *

**The efficiency of steam power units in sugar factories.** F. BONACKER. *Zuckererzeugung*, 1960, **4**, 370–372, 1961, **5**, 21–25.—A discussion, with formulae and diagrams, of power production from steam units and the relationships involved. The efficiency of turbines is especially covered and an example given of the method used to determine this efficiency.

* * *

**Diffusion constants for the extraction of sugar from beet.** V. M. LYSYANSKII. *Sakhar. Prom.*, 1961, (1), 15–19.—The studies made by a number of workers on the kinetics of diffusion are discussed. The need to take into consideration the outer diffusion resistance (the juice flowing along the cossette surface) by determining the coefficient of mass extraction is emphasized. This factor has been neglected in some calculations. The cossette must not be considered as a sphere or limited lamina in calculations for which equivalent dimensions of the cossette are required. With the presence of a limiting layer of juice over the surface of the cossette, there is no need to consider the deformation of the cossette, as the diffusion process will take place in all the cracks and crevices as well as in the remaining solid portion of the cossette. Values of the coefficient of mass extraction calculated by DRONOV[2] from non-static experiments using an empirical formula for static diffusion are compared with the values obtained by Lykov using a formula[3] derived for the same test conditions. The Dronov values are 280–300% higher. Tissue permeability must not be overlooked, as has been suggested by some authors.

* * *

**Determination of the total products in a rotary diffuser.** V. N. SHCHEGOLEV. *Sakhar. Prom.*, 1961, (1), 19–21.—Equations are developed for calculation of the sugar balance in a diffuser from the amount of juice and cossettes and their sugar contents. A worked example is presented.

[1] *Cf. I.S.J.*, 1960, **62**, 71.
[2] *I.S.J.*, 1958, **60**, 369.
[3] Theory of heat conductivity. (Moscow.) 1952.

**The use of polyacrylamide in filtration of beet juices.** V. A. DANIL'TSEV. *Sakhar. Prom.*, 1961, (1), 22–24.—A solution of polyacrylamide in ammoniacal water was used in filtration tests (factory and laboratory) in which it was added to 1st carbonatation juice. It resulted in faster settling and a thicker filter-cake which was easily washed off. The juice was transparent. Even with one of the two multi-tray clarifiers idle, the juice did not deteriorate at an increased factory capacity, and a filter-press pressure of only 1·5 atm. was required. However, according to tabulated data, the colour of 1st and 2nd carbonatation juices and thick juice was somewhat higher and the lime salts content of the thick juice greater (0·055% compared with 0·035%) without polyacrylamide treatment. In full-scale tests use of the polyacrylamide increased the clarifier station thoughput by 30%, allowing five 1st carbonatation filter-presses to be taken out of operation, the whole of the juice being handled by 2 clarifiers and 2 vacuum filters. Tests were also conducted on 0·1% solutions of polyelectrolytes added to the juice at 0·001%/100 Brix. The most effective of the polyelectrolytes, as regards settling and mud volume, was an emulsion of polyacrylamide with oleic acid. Sodium polymethacrylate and hydrolysed polyacrylamide with sodium alginate also gave good results. Normal polyacrylamide was ineffective in the treatment of juice from damaged beet.

* * *

**Simplifying and accelerating juice purification.** Z. D. ZHURAVLEVA and F. N. DOBRONRAVOV. *Sakhar. Prom.*, 1961, (1), 24–29.—Certain measures that should be adopted in beet juice purification are discussed. The use of hydrocyclones is endorsed, although the presence of some scum in the purified juice is pointed out. To prevent this the water used for diffusion should be as sterile as possible. Decomposition reactions in defecation sometimes are continued in the clarifiers, causing deterioration in the juice. To prevent decomposition of invert sugar, amides and pectin, defecation should be curtailed or completely omitted. The best method is the so-called "instantaneous defecation" (even better, it is claimed, than defeco-saturation) in which the lime is added just prior to carbonatation of the pre-limed juice in an amount just sufficient for the formation of $CaCO_3$ muds. Cold defecation is not practical mainly because of considerable foam formation, although cold pre-liming is recommended, especially with deteriorated beet. With instantaneous defecation the maximum pH of the sulphitated juice should be 7·5 before evaporation, as in a cane sugar factory.

* * *

**Ion exchange sorption of non-sugars and colouring substances from molasses solutions.** V. P. MELESHKO, I. M. VOITOVICH and G. A. CHIKIN. *Sakhar. Prom.*, 1961, (1), 30–33.—Laboratory tests on dilute beet molasses are reported, in which three cation exchange resins were used (KU-1, KU-2 and KB-4P2 with a dry resin capacity of 2·1, 3·9 meq/g for 0·5N KCl and 10·54 meq/g for 0·1N NaOH respectively), and 4 anion exchange resins (AN-2F, EDE-10P, AV-16 and AV-17, with respective capacities in 0·2N HCl of 4·5, 8·9, 7·3 and 2·6 meq/g). The molasses solution (200 g molasses diluted with 1 litre of water) was passed through at 1·5 ml/min and the filtrate drawn off in 10-ml samples. With the cation resins as given in the order above, the colour content was reduced by 74·8, 80·6 and 33·1%, while the colour reduction was of the order of 42%, 100%, 100% and 53% for the anion resins in the above order. The resin capacity was reduced (by 10–20%) only after the first 2 cycles, after which it was maintained at a constant level.

* * *

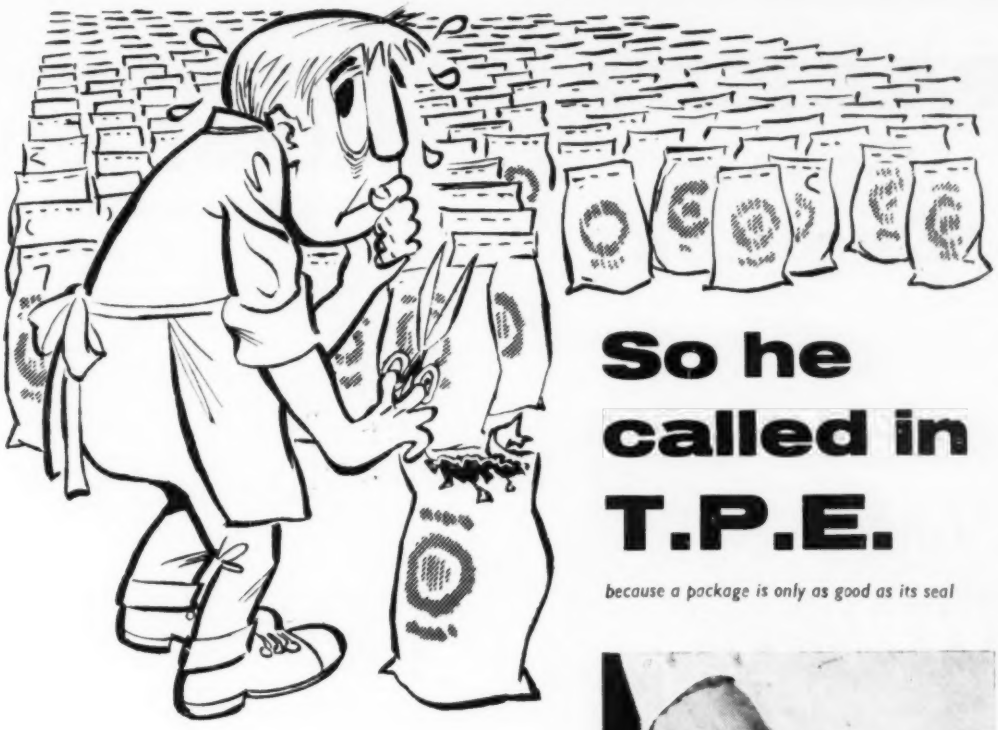
**Some technological features of processing of damaged beet and control of the technological production processes.** A. G. RYCHKAL'. *Sakhar. Prom.*, 1961, (1), 34–36.—The need to maintain a strict control of pH during juice purification processes is underlined, especially in the case of damaged beet. Special care should be taken during main liming, which, however, cannot be omitted as otherwise the decomposition processes will take place throughout the other processes in the factory. Lime salts should be precipitated by adding trisodium phosphate rather than sodium carbonate, as the latter causes an increase in evaporator scaling. Second carbonatation should be carried out at pH 9·5–9·8, and the filtered juice pH then reduced to pH 7·5–8·0 with $SO_2$, to avoid an increase in colour and a reduction in the alkalinity.

* * *

**Pressure regulator at the diffusion station of the Lenin sugar factory.** E. S. ZAKREVSKII. *Sakhar. Prom.*, 1961, (1), 37–38.—The unit, for regulation of the pressure of the condenser water used in the battery diffuser, consists of a manometer attached to the water feed pipe between a feed valve and the diffuser in circuit with a magnet and an electric motor controlling the feed valve. The manometer contacts mark the limits of the required pressure in the diffuser, so that if the pressure drops too low because of irregular juice draw-off, current flow to the motor causes the feed valve to open until the required pressure is attained. The circuit is then opened.

* * *

**Stone catching installation designed by S. Godwod.** ANON. *Gaz. Cukr.*, 1961, **63**, 13.—The stone catchers are in the form of funnels attached to the top of a pipeline. The stones, sand, etc. fall into these, but beet are kept afloat by an upsurge of water flowing under pressure through a side-tube into the funnel. Four of these are provided in the flume circuit.



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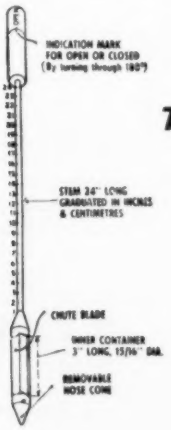
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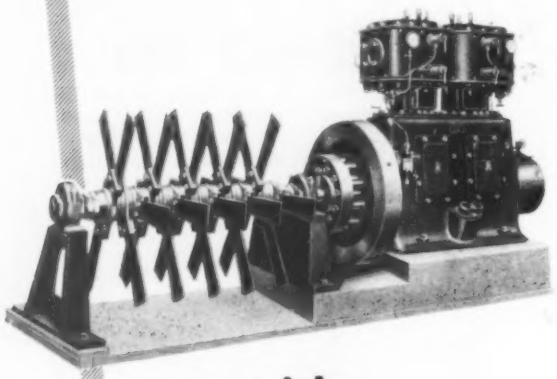

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# LABORATORY METHODS AND CHEMICAL REPORTS

**An assay of dry lead subacetate.** H. C. BHATTACHARYA and P. N. GANGULY. *Proc. 27th Conv. Sugar Tech. Assoc. India*, 1959, 144–146.—Analyses of two commercial samples of dry lead subacetate are reported. Total lead was 71·12 and 74·07% and basic lead 34·08 and 40·45% respectively. Water insolubles were 8·51% and 13·18%, indicating that the second sample contained more $Pb(C_2H_3O_2)_2.2PbO$: this explained its poor clarifying power in spite of its higher basicity.

* * *

**Conductimetric measurements of high purity sugar solutions.** G. PIDOUX. *Zucker*, 1961, **14**, 10–14.—See *I.S.J.*, 1961, **63**, 146.

* * *

**The use of the polarograph in the sugar industry.** I. PAULIK and O. TISZAVÁRY. *Cukoripar*, 1960, **13**, 329–336.—The applications of the polarograph to Ca determination are discussed, especially in the analysis of lime stone and of the lime salts content of juices. Analysis of these is based on the use of a zinc-EDTA complex, from which the Ca ions liberate an equivalent amount of Zn ions, which may be measured polarographically. Results of tests are given graphically and in table form.

* * *

**Polarographic determination of calcium in molasses using the disodium salt of ethylene diamine tetra-acetic acid.** N. A. RAMAIAH and S. D. SRIVASTAVA. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 72–77.—More sophisticated techniques for calcium determination are described, and an account given of a polarographic method whereby molasses is diluted to 10–12° Bx, adjusted to neutral pH and an indicator (potassium zincate/potassium chloride solution) added before titrating with EDTA solution. The method gives a sharp indication where the diffusion current falls steeply, and the results are 0 to 2·27% below those given by the oxalate method using the same molasses. The theory of the technique is described.

* * *

**Studies on the viscosity of sugar solutions: effect of lactic acid and its salts.** N. A. RAMAIAH and S. S. KATIYAR. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 78–82.—Lactic acid was neutralized with NaOH, KOH, $Ba(OH)_2$ and $Ca(OH)_2$ and the salts added to solution of sucrose as was lactic acid alone. The pH and the viscosity of the solutions were measured, the latter by a Höppler falling-ball viscometer, and the results tabulated. These show that lactic acid and its salts increase the viscosity, the effect being greater in the order Ba > Ca > Na > K lactate > lactic acid. Variation of pH of any one solution did not alter the viscosity which was more a function of the nature of the salt.

**Conductimetric studies on the formation of acids during heating of reducing sugar in the presence of alkalis.** N. A. RAMAIAH and G. D. CHANSARKAR. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 83–84.—A graph of conductance of a solution of glucose + NaOH, on titration with HCl, is in the form of two lines intersecting at the neutral point. After heating for one hour the curve is in the form of four lines joined consecutively, the 1st and 4th being approximately parallel to the original two. The intermediate two lines are attributed to the neutralization of organic acids formed by decomposition of the glucose. Since the length of one is about twice that of the other it is considered that there are either equimolecular parts of one mono- and one di-basic acid or two kinds of acid of different dissociation constants formed in a molecular proportion of 1:2: the latter is considered more likely.

* * *

**Potentiometic analysis of the decomposition products of destruction of reducing sugar in alkalis.** N. A. RAMAIAH, S. S. TATIYAR and G. D. CHANSARKAR. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 85–87.—Titration curves are prepared for HCl and a heated alkaline solution of glucose (see previous abstract) which had been added to an excess of HCl. The difference between the curves plotted *vs.* pH shows two points of inflexion, at pH 3·75 and pH 8·7, indicating two acidic groups. Formic acid has a pK value of 3·75 and lactic acid a pK of 3·86. No pK of 8·7 is found for lactic acid or any other acid previously identified as being produced by glucose decomposition; it is suggested that the dissociation constant corresponding to a pK of 8·7 is a hydroxylic or phenolic compound(s) formed during the reaction.

* * *

**Determination of ash by ion exchange. IV. A rapid method of estimation of ash in cane juice.** S. BOSE and K. C. GUPTA. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 88–90.—A technique similar to that of MUKHERJEE *et al.*[1] has been used in which the cane juice, diluted to 5–8° Bx, is passed through a column of "Duolite C-25" or "Amberlite IR 120" cation exchange resin on the $H^+$ cycle, the resin washed and the combined effluent and washings titrated with NaOH. The ash is best represented by the equation $y$ [sulphated ash in 100 ml juice] = $0{\cdot}0549x + 0{\cdot}149$, where $x$ is the volume of N acid.

* * *

**Kinetics of the caramelisation of sugars.** N. A. RAMAIAH and S. K. D. AGARWAL. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 101–104, 105–110.

The kinetics of caramelization in buffered solution have been studied by following the increase in colour

[1] *I.S.J.*, 1958, **60**, 274.

at 420 mμ (characteristic of caramel) with time. This colour development proved to be of first order for fructose, glucose and mannose, but it is argued that this is not significant since it is not known whether optical density is directly proportional to caramel concentration or if formation of caramel from the sugar is stoichiometric.

The amounts of sugar and/or alkali consumed with time were followed by taking samples at intervals from the reaction mixture (held in a thermostat bath), cooling, diluting and titrating to determine the reducing sugars and alkali. The results with glucose, fructose and mannose are presented in graph form and show the reaction to be of first order. Detailed investigations have shown the dependence of the reaction rate constant on the alkali concentration, indicating the pseudo-monomolecularity of the reaction.

* * *

**Estimation of magnesium.** S. C. SEN, D. SINGH and M. N. SINGH. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 137–138.—Comparative and replicate analyses were made of a standard magnesium sulphate solution using a volumetric method and three gravimetric methods—as phosphate by single and double precipitation and as quinolinate. The last was found to be most accurate and to have the smallest coefficient of variation.

* * *

**Kinetics of crystallization of sucrose.** B. N. DAS and N. A. RAMAIAH. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 189–195.—Literature references to the kinetics of sucrose crystallization are discussed and commented on.

* * *

**Inversion of concentrated and diluted sugar solutions.** S. K. D. AGARWAL, –. VISHNU, G. D. CHANSARKAR and K. K. RAO. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 207–210.—Experiments are described in which sucrose solutions were (*a*) buffered at various pH values and Brixes and maintained at 58°C for 2 hr (inversion increased with higher Brix and lower pH); (*b*) inverted by refluxing with HCl in the presence of NaCl at various sugar concentrations and pH values and for 1 or 2 hr (inversion increased as above and also with time of reflux); (*c*) boiled under reflux in the form of molasses and factory syrups undiluted and diluted to 15° Bx and adjusted to pH 5·0 with $SO_2$ (inversion was greater with higher Brix and was more marked with pure than with technical sugar solutions, the molasses being much less inverted than either pure sucrose or syrup under comparable conditions).

* * *

**Polarographic estimation of tin in products canned in sugar syrups.** J. P. SHUKLA, N. A. RAMAIAH and B. I. NEMADE. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 211–213.—A 200 c.c. portion of syrup is evaporated to dryness and heated with $H_2SO_4$ and ignited at 550°C for 4 hr. The sulphated ash is treated with concentrated HCl and made up to a known volume. An aliquot is treated with HCl and gelatin solution and diluted so that it is finally 1M with respect to HCl and contains 0·01% gelatin. A set of polarograms obtained in this manner were found to be well-defined and gave a linear relation between diffusion current and tin concentration. The method is suitable for routine work.

* * *

**Quick determination of crystal contents in massecuite and its application in reducing loss of sugar in molasses.** S. L. PHANSALKAR, H. C. BHATTACHARYA and N. N. JOSHI. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 214–216.—A series of synthetic massecuites were made up from crystal sugar and final molasses, molasses separated from a sample by means of a miniature Nutsch filter, and the crystal content of the massecuite calculated on a number of bases, including the *s-j-m* formula, reducing sugar analyses, ash analyses, and non-sugar analyses (variously Brix-pol, dry matter-sucrose and Brix-sucrose). From the results obtained with three massecuites it appears that the ash method is preferable, where crystal content is given by $100 - \frac{\text{Ash \% massecuite} \times 100}{\text{Ash \% molasses}}$.

* * *

**Determination of the colour of plantation white sugars.** N. A. RAMAIAH and –. VISHNU. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 237–241.—Solution colour (measured as difference between optical densities at 420 mμ and 550 mμ) and reflectance tristimulus values were determined for sugars of different grain sizes obtained from the same massecuites. Solution colour was found to be independent of grain size, while reflectance measurements showed that smaller grain sugar appeared whiter than larger grain sugar.

* * *

**Nitrogenous compounds in the beet leaf.** M. ARVIDSSON and E. SWIETLICKA. *Socker Handl.* II, 1960, **16**, (3), 17–30.—Details are given, with 25 references to the literature, of beet analyses using acid and alkaline hydrolysis (the latter for determination of tryptophan), with paper chromatographic determination of the isolated amino acids. It was found that amino destruction proceeded with hydrolysis, which was not complete after 14 hr. A 24 hr hydrolysis gave fairly representative values as a compromise between complete hydrolysis and least possible destruction. Tables are given of the amino acid content of the coagulate after varying periods of acid hydrolysis and of the free amino acid content expressed as μmol N/g leaf dry matter. The total identified amino acids contents were 1828 (24 hr hydrolysis) and 17·8 μmol N/g dry matter respectively, out of N totals of 2278 and 32·8 μ mol/g, of which 330 and 6·0 μ mol/g represented $NH_3$.

# BY-PRODUCTS

**An investigation on the possibilities of the use of molasses for the production of 2,3-butanediol by certain diol-forming bacteria[1].** K. BAHADUR and S. RANGANAYAKI. *Indian J. Appl. Chem.*, 1960, **23,** 3–8; through *S.I.A.*, 1960, **22,** Abs. 999.—The formation of 2,3-butanediol from diluted and purified cane molasses by different bacteria species was investigated. *Aerobacter aerogenes* forms no 2,3-butanediol and acetoin in the first period of 10 days, but these compounds are formed later and sugar consumption is then reduced. The optimum pH value appeared to be 7·5. *Bacillus polymyxa* equally shows no formation of 2,3-butanediol and acetoin for 11 days. Thereafter increasing quantities are formed, 2,3-butanediol at the optimum pH 7·0 and acetoin at the optimum pH 8·0, but sugar consumption also increased. No acetoin formation was observed with *Serratia marcescens*, *Bacillus subtilis* and *Aeromonas hydrophila*, all of which consumed sugar. Optimum pH values for 2,3-butanediol formation were 8·0, 6·5 and 7·0 respectively. An appreciable quantity of 2,3-butanediol was formed by *Pseudomonas hydrophila* at pH 7·5, with only slight sugar consumption.

* * *

**Conditions governing the growth of Torula yeast in cane molasses.** J. P. SHUKLA and K. C. GUPTA. *Proc. 27th Conv. Sugar Tech. Assoc. India*, 1959, 55–58.—The best yield of *Torula utilis* var. Major, using sulphitation molasses as carbohydrate source, was obtained in the presence of 1·0–1·2% total reducing matter (2–2·5°Bx molasses), nitrogen to the extent of 1–1·5 formalin number, 12·5–15 mg $PO_4$/100 c.c., 5·0–6·0 pH, and aeration at the rate of 0·5 cu.ft. air/gallon of wort. These conditions gave an average of 200–205% wet yeast (77·7% moisture, 2·58% ash) on total reducing matter.

* * *

**Effect of sulphitation press mud extract on growth of Torula yeast under aeration in cane waste molasses.** J. P. SHUKLA, B. D. KAPOOR and K. C. GUPTA. *Proc. 27th Conv. Sugar Tech. Assoc. India*, 1959, 59–61.—Torula yeast was grown under the conditions above (preceding abstract) but in the presence of an extract (9% by volume of wort) made by triturating one part of press mud with 4 parts of water at pH 4 5 and 60 C, standing for 1 hr, separating the liquid and centrifuging. The extract promoted yeast growth and increased the yield by 30%.

* * *

**Depithing of bagasse for paper making.** B. BISWAS and J. B. LAL. *Proc. 27th Conv. Sugar Tech. Assoc. India*, 1959, 108–112.—The subject is reviewed with 33 references to the literature.

* * *

**Rice bran as accelerator of the alcoholic fermentation of refinery molasses.** B. G. KRISHNAMURTHI. *Indian Sugar*, 1960, **10,** 473–484.—Studies are reported in which rice bran, Bengal gram powder and velum bark were found to accelerate alcoholic fermentation of molasses, measured as a function of the attenuation of the fermenting wash s.g. or of the loss of weight due to escape of $CO_2$. The acceleration caused by rice bran, considerable in the presence of ammonium sulphate, was almost at a maximum when added at 1 g/100 c.c. of wash. Bengal gram powder and velum bark have a lower accelerating effect than the bran, the velum bark being inferior to the gram powder. The effect of bran, which is in the form of small disintegrated particles, is to supply nutrition to the yeast, a secondary effect being to help the release of $CO_2$. Fermentation in the presence of bran of a wash of s.g. 1·1 proceeds at a greater rate than with a wash of s.g. 1·05 without bran, The accelerating effect is most marked at s.g. 1·05. When added at 0·5 and 1 g/100 c.c. wash, in the presence of 0·1 g ammonium sulphate, the bran raised the maximum hourly rate of $CO_2$ production to respectively 8·5% and 10·0% of the total theoretical yield of $CO_2$. Alcohol yields are not affected by the bran.

* * *

**Invert sugar from sucrose by the ion exchange process.** S. BOSE, I. S. JUNEJA and S. MUKHERJI. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 201–206.—A series of experiments are described in which the rates of inversion of sucrose solutions were measured for different conditions of Brix, temperature and quantity of resin ("Amberlite IR-120"). The invert sugar solution produced is water-white and free of ash and decomposition products. It is thus very suitable for use in confectionery, etc. The resin may be recovered and re-used several times, so lowering production costs, and conditions may be adjusted to give any required degree of inversion.

* * *

**Fermentability of cane waste molasses produced by the deionization process for ethanol production.** J. P. SHUKLA, S. N. PANDEY and B. D. KAPOOR. *Proc. 28th Conv. Sugar Tech. Assoc. India*, 1960, 227–230.—Clarified juice obtained by sulphitation was partly concentrated and boiled to molasses in a normal way, and partly deionized with "Duolite C-25" and "Duolite A-7" resins in a mixed bed before concentrating and subjected to a four-massecuite boiling scheme. Molasses analyses were: 84·5° (normal) and 70·5°Bx (deionization); 59·6 and 81·8% total reducing matter on Brix; 2·6 and 1·3% unfermentables and 10·0 and 2·0% ash. Fermentation experiments showed that the deionized molasses gave higher fermentation efficiencies, but fermentation time and start of fermentation was delayed because of the removal of certain inorganic constituents. Less yeast is formed as a result of removal of substances essental to yeast growth.

[1] *Cf. I.S.J.*, 1959, **61,** 285.

## UNITED KINGDOM

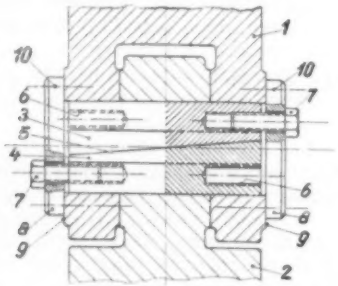
**Beet harvester.** C. J. STEKETEE, of Driewegen, Holland. **862,440.** 16th October 1959; 8th March 1961.

* * *

**Extraction of sugar.** N.V. CENTRALE SUIKER MIJ. FABRIEK "WITTOUCK", of Breda, Netherlands. **864,429.** 8th August 1958; 6th April 1961.—Cossettes are first treated (in an atmosphere saturated with $CHCl_3$ vapour) at 35°C–45°C (40°C) with an agent which will render the cell wall permeable to sugar (0·025–0·05% of $SO_2$) and then with chloroform after which it is subjected to diffusion in water at a temperature between ambient and 50°C in a partly-evacuated tank or revolving drum, the $SO_2$ treatment lasting >10 sec (up to 5 sec) and the $CHCl_3$ treatment 5–15 (10) min.

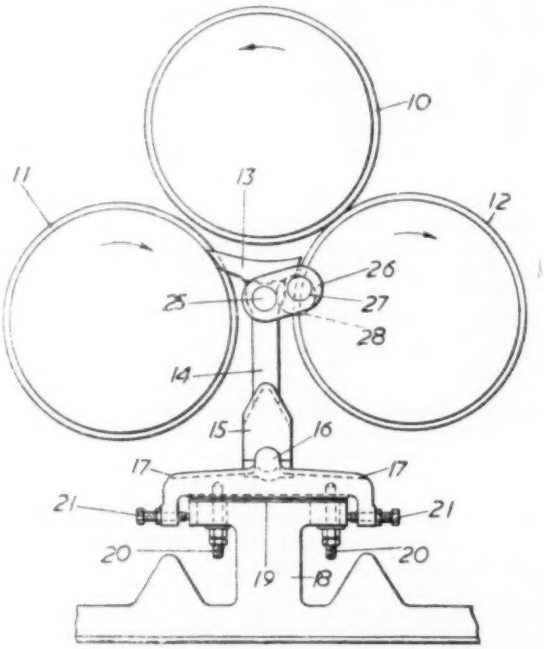
* * *

**Roller supports of cane mills.** GUTEHOFFNUNGSHÜTTE STERKRADE A.G., of Oberhausen, Rhineland, Germany. **865,191.** 8th July 1957; 12th April 1961.—The upper and lower parts of the cane mill housing 1, 2 pivot about the joint shown, the tongue of the lower part fitting between the sides of the fork of the



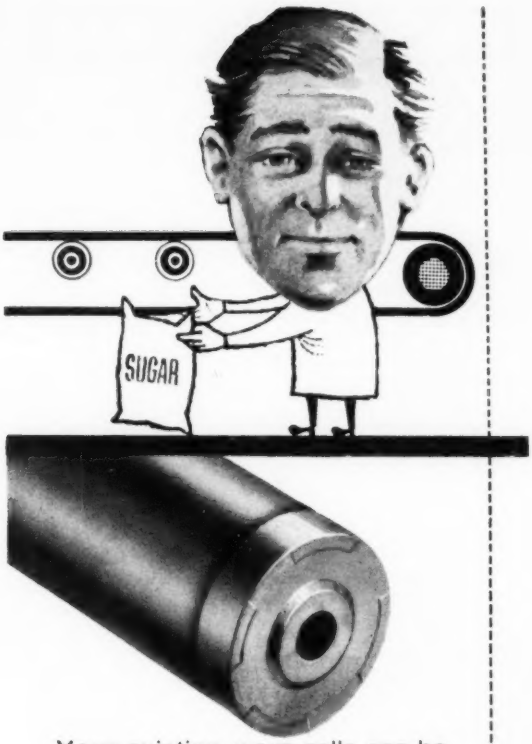

upper part, each being drilled and aligned to permit insertion of the bolt. This bolt is composed of two parts 3, 4 having co-acting inclined plane surfaces 5 and tapped with holes 6 to hold screws 7 for locking or releasing the bolt. Each screw 7 passes through a hole in the cover plate 8 which is held against the housing part 1 by screws indicated by their centre lines at 10. As the screws 7 are turned, the halves of the bolt are drawn against each other, increasing the effective bolt diameter and holding the housing together rigidly without the play necessary when the bolt is a solid shaft.

**Trash turners for (cane) crushing mills.** GEORGE FLETCHER & Co. LTD. and H. A. WATTS, of Derby, England. **866,346.** 12th February 1960; 26th April 1961.—The trash plate 13 of the cane mill illustrated meshes with the feed roller 11 and is mounted on a support 14 carried by a bridge 15 on a trunnion 16. The trunnion is mounted on a fulcrum bracket 17 which is in turn supported on a base plate 18. The bridge is adjustable vertically by means of packing plates 19 and screw jacks 20, and is adjustable laterally by means of set screws 21. The trash turner




has a lug 25 forming an axis about which a link 26 can pivot, and the link receives a pin 27 mounted eccentrically on a crankshaft 28 which passes through the headstock 30 and has a peg wheel 31 fastened to its opposite end. The peg wheel has a series of slots 32 around its periphery in any of which a peg bar 33 can engage, the peg bar being carried by a lever 34. The lever 34 is pivotally movable about the shaft 28, and has drawbolts 36, 37 connected to its opposite end, the drawbolts passing through brackets 38, 39 on the headstock and being operated by nuts 40, 41. The peg bar 33 is urged into engagement with

Copies of Specifications of United Kingdom Patents can be obtained on application to H.M. Patent Office, 25 Southampton Buildings, London, W.C.2. (price 3s. 6d. each). United States patent specifications are obtainable from: The Commissioner of Patents, Washington, D.C. (price 25 cents each).

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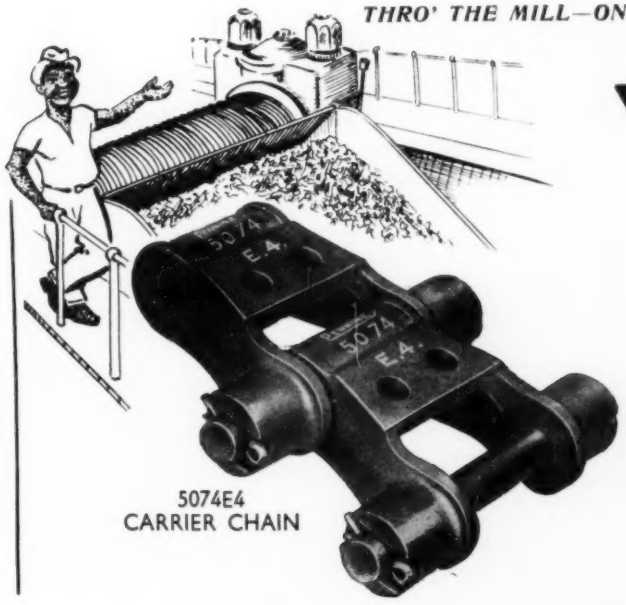


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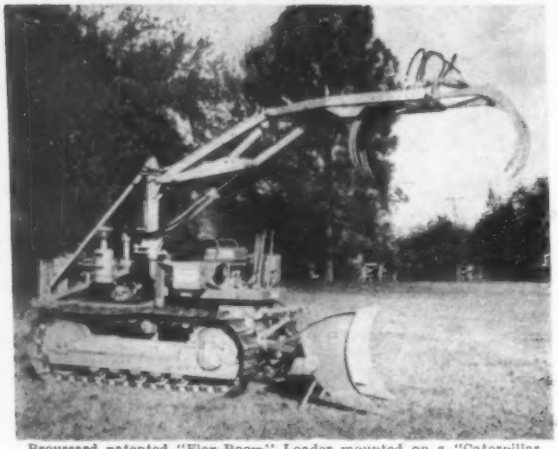

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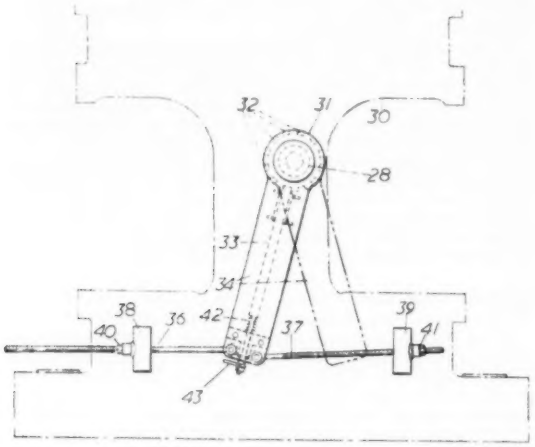
the slots in the peg wheel by the action of a spring 42 and is fitted with a handle 43 for disengaging it when required. In operation, the drawbolts can be used to act on the lower end of the lever 34 and impart




movement to it as indicated by the two positions of the lever shown. By this movement the peg bar 33 will turn the peg wheel 31 and crankshaft 28. The lever can be used to give a positive rotation to the crankshaft in either direction. The crankshaft in turn acts upon the eccentric pin 27 and so by means of the link 26 the desired movement is imparted to the trash plate 13 to move it towards or away from the feed roll 11 as the operator may desire.

* * *

## UNITED STATES

**Animal feed supplement.** B. KVIESITIS, assr. VY LACTOS LABORATORIES INC., of Des Moines, Iowa, U.S.A. **2,967,106.** 4th March 1959; 3rd January 1961.—Molasses is dehydrated to a dry state and mixed with 2% of lecithin to give an animal feed supplement.

* * *

**Removal of coloured bodies from aqueous crude sugar solutions.** L. J. LEFEVRE and W. I. CHILDS, *assrs.* DOW CHEMICAL CO., of Midland, Mich., U.S.A. **2,970,071.** 19th February 1959; 31st January 1961.—The crude sugar solution is contacted with an insoluble cross-linked copolymer of a mixture of a monovinylaryl hydrocarbon (styrene) having the vinyl group as its sole unsaturation with 0·2–20 molar % of a copolymerizable cross linking agent (divinyl benzene) which contains at least 2 groups of the structure $CH_2 = C<$. The copolymer has attached to its aryl nuclei – $CH_2$ – N – methylglucamine groups.

* * *

**Production of citric acid by fermentation.** L. B. SCHWEIGER *assr.* MILES LABORATORIES INC., of Elkhart, Ind., U.S.A. **2,970,084.** 21st January 1958; 31st January 1961.—*Aspergillus niger* is used to bring about submerged fermentation of a medium containing organic nutrient derived from an impure carbohydrate source, (e.g. high test molasses, invert sugar, corn syrup) and not less than 0·2 p.p.m. of iron, to which is added 0·1–500 (e.g. 50) p.p.m. of ionic copper either before, during or up to 50 hr after inoculation. This results in control of the cellular morphology to give an acid-producing cellular structure.

* * *

**Preparing drying oils from sucrose and raffinose** H. B. HASS, *assr.* SUGAR RESEARCH ROUNDATION INC., of New York, N.Y., U.S.A. **2,970,142.** 28th February 1956; 31st January 1961.—One mol of sucrose or raffinose is heated at 20–120°C (80–110°C) with 6 moles of an ester of a volatile lower alcohol and a drying oil fatty acid (a conjugated poly-unsaturated fatty acid). Heating is in an organic solvent (*N,N*-dimethylformamide) and in the presence of an alkaline catalyst which produces the characteristic colour when added in 1% w/v solution to a 0·5% w/v phenolphthalein solution in 1:1 boiled *N,N*-dimethylformamide:$CO_2$-free water. The volatile alcohol liberated in the reaction is continuously removed under vacuum.

* * *

**Ion exchange process.** G. ASSALINI, *assr.* ROHM & HAAS CO., of Philadelphia, Pa., U.S.A. **2,971,868.** 2nd May 1958; 14th February 1961.—The particles in an ion (cation) exchanger resin bed are at least half in a salt form, this portion being at the effluent end of the bed, while the particles at the influent end are other than in salt form, being derived by regeneration with a non-salt electrolyte. Through the bed are passed an impure sugar solution (molasses, particularly *A*-molasses) (5–35% on bed volume), water sufficient to remove the sugar from the bed (1–4 volumes per volume of sugar solution), a regenerant to restore the influent half of the bed to its original form, and water to flush away the salts liberated by the regenerant. The sugar effluents are in 3 fractions, the first of higher and the last of lower purity than the original solution and the second intermediate between these two; this last fraction is returned to the column. The purified sugar effluent may be concentrated and crystallized or a non-salt electrolyte added to bring its pH to 5–9; or it may be passed through a bed of weakly polar ion (anion) exchange resin which has been regenerated with a non-salt electrolyte of opposite basicity to that used to regenerate the first resin bed. Alternatively, the original sugar solution may be purified by passing in two streams through columns as above, the resins having exchangeable ions of opposite basicity, the purified sugar effluents then being mixed. The purified sugar solution may be returned to an earlier stage of the extraction process (e.g. to the clarified juice).

* * *

**Beet harvester and cleaner.** H. E. ERDMAN, of Crookston, Minn., U.S.A. **2,972,383.** 16th March 1959; 21st February 1961.

# TRADE NOTICES

*Statements published under this heading are based on information supplied by the firm or individual concerned. Literature can generally be obtained on request from the address given.*

**Low conductivity electromagnetic flowmeter.** Fischer & Porter Ltd., Salterbeck Trading Estate, Workington, Cumberland.

A new low conductivity electromagnetic flowmeter system has been developed which considerably extends the range of applications on which this type of flowmeter may be used. Hitherto it has been impossible to use magnetic flowmeters for handling fluids with a conductivity of less than 20 micromhos/cm, but with the introduction of certain design changes Fischer & Porter have produced a magnetic flowmetering system which will handle liquids and slurries with a conductivity as low as 0·1 micromhos/cm. This means that the rate of flow of fluids not far removed from pure hydrocarbons can now be accurately determined by this magnetic meter. The electromagnetic flowmeter is obstructionless, accurate, simple, rugged, bi-directional and unaffected by changes in viscosity or density.

* * *

**Automatic weigher for mixing.** Electroweighers (Birmingham) Ltd., Moseley Street, Birmingham 12.

In a new unit, a material "A" is weighed on an electronic continuous belt weigher. This includes a linear inductive load cell, generating voltage signals which are fed from the weigher control unit to an electronic sampler and memory unit. This registers average load and retains the signal for the requisite time (up to 45 sec) before operating a servo-motor driven toroidal transformer driving a vibratory feeder. The voltage output of this in turn varies the flow of material "B" onto the conveyor or other mechanism prior to mixing with material "A".

* * *

## PUBLICATIONS RECEIVED

**"COMMANDER" FLOAT-OPERATED OPEN-CHANNEL FLOW-MEASURING INSTRUMENTS.** George Kent Ltd., Luton, Beds.

In specification sheet SS 013 appear specifications, illustrations, dimensions and mounting details of circular chart indicators, recorders and recorder/controllers, sector scale indicators and indicator/controllers and blind electric transmitters.

* * *

**CANE LOADERS.** Motocana S/A., Avenida 1° de Agosto, 272, Piracicaba, São Paulo, Brazil.

A new leaflet describes and illustrates a cane loader provided with a stabilizer to permit operation on sloping ground and capable of loading 220 tons of cane in a normal working day. It is self-propelled by means of a diesel engine. A second type of tractor-mounted cane loader is also illustrated with the same capacity. Technical data on the two loaders are provided.

**Renold RL Clutches.** Renold Chains Ltd., Renold House, Wythenshawe, Manchester.

A new addition to the Renold range of power transmission equipment, the RL (Reversible locking) Clutch, is described in a new booklet, Catalogue 316/534.The clutch consists of a circular outer race containing two co-axial inner races which act as controller and follower. Two sets of special locking elements are mounted between the follower and outer race, one set arranged for driving clockwise and the other driving anti-clockwise. Slight angular movement of the controller actuates a set of shoes which unlocks one or other set of elements, thus providing reversibility of drive. Typical applications include hoists, conveyors, printing and packing machinery as well as reversible machinery of all kinds.

* * *

**Industrial maintenance coatings.** Camrex Paints Ltd., Camrex House, Hudson Rd., Sunderland, Co. Durham.

A new booklet describes the wide range of surface coatings produced by Camrex Paints Ltd. specially intended for maintenance painting in industry. They include 21 different types of primer, four types of undercoat, fourteen types of finishing coat, as well as varnishes and special coatings, for example, for resistance to acid and alkali attack, salt water, abrasion, moulds, etc.

* * *

**Multiple level controllers LR8.** Elcontrol Ltd., Wilbury Way, Hitchin, Herts.

Data Sheet LR/A gives details of the LR8 multiple level control panels which provide up to twelve control or alarm stages in steps of two. The advantages of the panels over the single stage controllers are their reduction in panel size, reduction in site wiring, simplified testing and fault-finding, and easily replaced individual chassis.

* * *

**Recording counters.** Cambridge Instrument Co. Ltd., 13 Grosvenor Place, London S.W.1.

List 143/1 describes the Cambridge recording counters which record the frequency, clock time and duration of industrial processes or machine operations, tracing this information on circular charts which indicate by default when the machine or process is stopped. A wide range of single or multi-pen recorders is manufactured, operated by either mains or battery, and combined counters and temperature or pressure recorders can be supplied.

* * *

**Hardinge thickeners.** International Combustion Products Ltd., 19 Woburn Place, London W.C.1.

A new booklet, IC G 6010, describes and illustrates the Hardinge design of sedimentation equipment for sludge-bearing liquids. It is available in single and multi-tray form, with concrete or steel tanks, and embodies the usual conical base on which the settled muds are brought to the central discharge point by rakes mounted on arms supported by a slowly rotating central shaft.

* * *

**Lagonda tube cleaners.** Consolidated Pneumatic Tool Co. Ltd., 232 Dawes Rd., London S.W.6.

Catalogue 48c illustrates and provides specifications of the Lagonda range of tube cleaning equipment which includes a range of cleaner and scraper heads, brushes, couplings, motors, lubricators, hose, valves and sleeving. The cleaners can be used for straight or curved tubes of all types, including boiler tubes and calandria tubes, etc., of diameters from 0·370 inches to 20½ inches.

* * *

**Hesser centenary.**—This month marks the centenary of the founding of Fr. Hesser Maschinenfabrik A.G., the makers of high-speed packaging equipment used widely in the sugar refining industry.

## Japan Sugar Imports[1]

*Metric tons, tel quel*

| | 1958 | 1959 | 1960 |
|---|---|---|---|
| Australia | 145,317 | 109,796 | 122,407 |
| Brazil | 69,844 | 95,323 | 183,451 |
| British Guiana* | — | — | 783 |
| Cuba | 515,967 | 388,594 | 205,793 |
| Denmark | — | 3 | 2 |
| Ecuador | 19,601 | 6,223 | 7,503 |
| Fiji | — | 14,366 | 11,711 |
| Haiti | 44 | — | — |
| Indonesia | — | — | 1,327 |
| Mauritius | 14,370 | — | — |
| Nicaragua | — | 12,218 | — |
| Norway | — | — | 2 |
| Papua | — | 1,000 | — |
| Peru | 33,169 | 98,460 | 111,052 |
| Philippines | 400 | 19,188 | 47,583 |
| Ryukyu | 41,196 | 45,114 | 50,291 |
| Dominican Republic | 70,663 | 61,526 | 79,516 |
| Taiwan | 310,637 | 364,031 | 459,932 |
| United Kingdom | — | 14 | 90 |
| U.S.A. | — | 60 | 165 |
| Venezuela | — | — | 2,648 |
| Other Countries | †1,777 | — | — |
| | 1,222,985 | 1,215,916 | 1,284,256 |

* No sales of sugar were reported from British Guiana to Japan during 1960. It is possible that this quantity was described as "Demeraras" although originating in Brazil.

† The total of "Other Countries" may include imports from countries which are, in fact, separately specified.

[1] C. Czarnikow Ltd., *Sugar Review*, 1961, (499), 59.

## Canada Sugar Imports[2]

| *Raw sugar imported by refiners* | 1958 *tons* | 1959 *tons* | 1960 *tons* |
|---|---|---|---|
| Australia | 121,612 | 173,072 | 164,055 |
| Barbados | 13,000 | 27,820 | 15,710 |
| British Guiana | 99,128 | 87,365 | 91,610 |
| Cuba | 183,427 | 78,057 | 49,214 |
| Dominican Republic | 3,201 | — | — |
| Fiji | 49,084 | 54,923 | 71,310 |
| Jamaica | 71,406 | 112,726 | 104,160 |
| Leeward and Windward Is. | 11,600 | 17,509 | 7,112 |
| Mauritius | 63,143 | 86,880 | 25,890 |
| South Africa | — | 5,000 | 20,530 |
| Trinidad | 25,913 | 24,616 | 46,410 |
| | 641,514 | 667,968 | 596,001 |
| *Raw sugar N.O.P.* | | | |
| Barbados | 1 | 3 | — |
| British Guiana | 4,213 | 3,411 | 2,934 |
| Cuba | 7,069 | 8,145 | 8,135 |
| | 11,283 | 11,559 | 11,069 |
| *Refined sugar* | | | |
| Barbados | — | 500 | — |
| Czechoslovakia | 5 | — | — |
| Holland | 600 | — | 2 |
| Hong Kong | — | — | 197 |
| Mexico | 2,946 | — | — |
| United Kingdom | 2 | 3 | 4 |
| United States | 8 | 81 | 65 |
| | 3,561 | 584 | 268 |

[2] Dominion Bureau of Statistics; through C. Czarnikow Ltd., *Sugar Review*, 1961, (503), 74.

# BREVITIES

**New Thailand sugar mill.**[3]—A new sugar mill was recently opened at Pranbuti in Thailand by the Minister for Industry. The mill, equipped with Japanese machinery and operated by Japanese and Taiwanese sugar experts, uses the carbonatation process and is the first in Thailand to manufacture sugar by this method.

* * *

**Argentina sugar crop, 1960**[4].—A total of 9,559,751 metric tons of cane were crushed in the 1960 season, yielding 782,374 tons of sugar, a recovery of 8·184%.

* * *

**Iran–U.S.S.R. trade agreement**[5].—A trade agreement between the Soviet Union and Iran signed late in October 1960 provides for the delivery of 50,000 tons of Russian sugar to be paid for in Iranian currency and to be delivered to the North Iran provinces of Khorasan and Mazandaran.

* * *

**Belgian beet sugar crop, 1960/61**[6].—Despite a reduction in the sugar beet area last season, favourable growing conditions resulted in an excellent beet crop and the record sugar outturn of 457,005 metric tons, white value, which compares with only 190,917 tons in the previous campaign.

* * *

**Bagasse newsprint in India**[7].—The Minister of Industry stated in the Lok Sabha on the 13th December 1960 that the proposal for setting up a bagasse newsprint factory in Maharashtra at a cost of Rs.100,000,000 (£7,500,000) had been approved in principle by the Government but a final licence had not been issued.

**Sugar expansion in Honduras**[8].—A fourth factory is to be built near San Juan de Flores in the Department of Choluteca.

* * *

**Sugar refinery for El Salvador**[9].—El Salvador's first refinery at Apopa was completed in October 1959. Its annual capacity is estimated at about 33,000 tons of refined sugar.

* * *

**New factory plans for Ecuador**[10].—Cia. Industrial Monterrey Azucarera Lajana C.A. plan the erection of a cane sugar factory in the Catamayo Valley in the Province of Loja.

* * *

**Venezuela sugar expansion.**[11]—A sugar factory with a daily processing capacity of 250 tons of cane was put into operation at Santa Maria, near La Tascosa in the state of Monagas, in February 1960. During its first year it processed cane from only 1900 acres and its sugar extraction was only 8%. In 1961, cane from 5000 acres is to be crushed and it is hoped to increase extraction. Two further factories are to be built at Cariaco in the state of Sucre, and Acarigua in the state of Portoguesa, of 1450 and 2000 tons daily crushing capacity, respectively.

[3] C. Czarnikow Ltd., *Sugar Review*, 1961, (503), 74.
[4] *La Industria Argentina*, 1961, **66**, 10–11.
[5] F. O. Licht, *International Sugar Report*, 1960, **92**, (Supp. 22), 288.
[6] C. Czarnikow Ltd., *Sugar Review*, 1961, (495), 41.
[7] *Indian Sugar*, 1960, **10**, 572.
[8] F. O. Licht, *International Sugar Report*, 1961, **93**, (2), 27.
[9] F. O. Licht, *International Sugar Report*, 1961, **93**, (2), 27.
[10] F. O. Licht, *International Sugar Report*, 1961, **93**, (2), 28.
[11] F. O. Licht, *International Sugar Report*, 1961, **93**, (2), 28.

# BREVITIES

**Names for South African cane varieties.**—It is noted in the *South African Sugar Journal*[1] that, for the future, all new varieties will be given names at the pre-release stage.

* * *

**Mexican sugar expansion.**[2]—Mexico plans to increase sugar production by intensified cane cultivation while two new mills are to be constructed in the Tepalcatep. c Basin and in Cihuatlan, Jalisco. Installation of a mill in Valles, in the Potosí Huasteca is progressing satisfactorily. Production this year is estimated at 2,000,000 tons compared with 1,870,000 tons last year and 886,000 tons in 1955. Exports this year are expected to be between 550,000 and 770,000 short tons and it is hoped to increase this to 1,100,000 tons.

* * *

**New sugar factories for India**[3].—The Mysore Government has decided that the location of the ten factories to be built during the 3rd Plan period will be Kamalpura in Bellary District, Gouribanour in Kolar District, Mugatkhan Hubli in Belgaum District, Bidar or Uddur in Mandhya district, Nanjangud, Krishnarajanagar and Chunchanakatte in Mysore District, Biriyur and Harihar in Chitradurga district, and Tarikere in Chikmagalur district. The Minister for Co-operation in Maharashtra said in February that seven new sugar factories would be opened in the State. In Andhra Pradesh work is progressing on the five sugar factories already licensed, while two further factories are planned at Tuni and Bhimasingi in Visakhapatam District. In Gujerat a new sugar factory is to be set up soon at Nabipur, while there are favourable prospects for establishment of a factory at Jalpaiguri in West Bengal.

## Stock Exchange Quotations

| | CLOSING MIDDLE |
|---|---|
| **London Stocks** (*at 17th May*, 1961) | |
| Anglo-Ceylon (5s) | 13/9 |
| Antigua Sugar Factory (£1) | 11/3 |
| Booker Bros. (10s) | 29/- |
| British Sugar Corp. Ltd. (£1) | 25/6 |
| Caroni Ord. (2s) | 4/1½ |
| Caroni 6% Cum. Pref. (£1) | 14/- |
| Distillers Co. Ltd. (10s units) | 41/10½ |
| Gledhow Chaka's Kraal (£1) | 41/6 |
| Hulett & Sons (£1) | 45/- |
| Jamaica Sugar Estates Ltd. (5s units) | 4/1½ |
| Leach's Argentine (10s units) | 21/3 |
| Manbré & Garton Ltd. (10s) | 50/6 |
| Reynolds Bros. (£1) | 32/6 |
| St. Kitts (London) Ltd. (£1) | 19/9 |
| Ste. Madeleine (Ord.) (£1) | 28/- |
| Sena Sugar Estates Ltd. (10s) | 11/3 |
| Tate & Lyle Ltd. (£1) | 54/6 |
| Tate & Lyle Investments Ltd. (5s) | 17/4½ |
| Trinidad Sugar (5s stock units) | 40/- |
| United Molasses (10s stock units) | 36/- |
| West Indies Sugar Co. Ltd. (£1) | 17/- |

| | CLOSING MIDDLE |
|---|---|
| **New York Stocks** (*at 16th May*, 1961) | $ |
| American Crystal ($10) | 55 |
| Amer. Sugar Ref. Co. ($25) | 33 |
| Central Aguirre ($5) | 25⅛ |
| Cuban American ($10) | 17½ |
| Great Western Sugar Co. | 35⅜ |
| South P.R. Sugar Co. | 18⅛ |
| United Fruit Co. | 19⅜ |

**Danish factory closed**[4].—With the end of the 1960/61 campaign, the Hojbygaard sugar factory has been closed.

* * *

**Rhodesian sugar industry development**[5].—It is planned to commence work shortly on a £5 million development scheme to further the production of sugar in Southern Rhodesia. The preparation of new land, estimated to be about 12,000 acres, for cane cultivation is to be undertaken whilst the construction of a new mill which will have an annual capacity of some 75,000 tons of sugar is expected to commence in the very near future.

* * *

**Cane diffusion in Jamaica.**—It is reported[6] that the cane farmers of Hanover parish are negotiating with a U.S. Company for the building of a modern sugar factory in the parish, the new plant to use the diffuser method of extracting cane juice.

* * *

**Chile sugar production**[7].—Production of beet sugar in Chile during 1960 amounted to 70,000 tons, according to the Export Services Branch of the Board of Trade. This figure represents an increase of some 13,000 tons over that outturned in the 1959 season and is about 30,000 tons more than was manufactured in the previous crop.

## European Sugar Beet Area*

| | *Hectares* | | |
|---|---|---|---|
| *Western Europe* | 1961 (*Estimate*) | 1960 | 1959 |
| Western Germany* | 275,000 | 299,198 | 294,801 |
| Austria | 37,100 | 44,336 | 55,382 |
| France | 300,000 | 373,000 | 354,000 |
| Belgium/Luxembourg | 65,900 | 67,221 | 68,757 |
| Netherlands | 87,000 | 92,513 | 92,979 |
| Denmark† | 35,200 | 50,104 | 50,377 |
| Sweden | 50,600 | 50,652 | 51,096 |
| Italy | 230,000 | 239,000 | 302,100 |
| Spain | 180,000 | 175,000 | 190,000 |
| Yugoslavia | 80,000 | 70,700 | 74,579 |
| Switzerland | 5,300 | 5,323 | 5,433 |
| U.K. | 168,500 | 168,031 | 166,365 |
| Ireland | 31,500 | 27,338 | 27,703 |
| Finland* | 17,000 | 15,226 | 14,266 |
| Turkey | 135,000 | 202,902 | 164,065 |
| Total Western Europe | 1,698,100 | 1,880,544 | 1,911,903 |
| *Eastern Europe* | | | |
| Eastern Germany | 240,000 | 238,000 | 225,000 |
| Czechoslovakia | 245,000 | 241,000 | 242,267 |
| Hungary | 135,000 | 132,100 | 122,600 |
| Poland | 410,000 | 400,700 | 375,700 |
| Roumania | 215,000 | 210,000 | 201,400 |
| Bulgaria | 75,000 | 75,000 | 77,000 |
| U.S.S.R. | 3,300,000 | 3,056,000 | 2,750,000 |
| Total East Europe | 4,620,000 | 4,352,800 | 3,993,967 |
| TOTAL EUROPE | 6,318,100 | 6,233,344 | 5,905,870 |

* Excluding area of beet from other countries.

† Including area for sugar beet grown for export to other countries.

[1] 1960, **44**, 1033.
[2] *Sugar y Azúcar*, 1961, **56**, (4), 46.
[3] *Indian Sugar*, 1961, **10**, 692.
[4] F. O. LICHT, *International Sugar Report*, 1961, **93**, (Supp. 7), 88.
[5] C. Czarnikow Ltd., *Sugar Review*, 1961, (504), 79.
[6] *Fortnightly Review* (Bank of London & South America Ltd.), 1961, **26**, 417.
[7] C. Czarnikow Ltd., *Sugar Review*, 1961, (506), 87.
[8] F. O. Licht, *International Sugar Report*, 1961, **93**, (4), 59.

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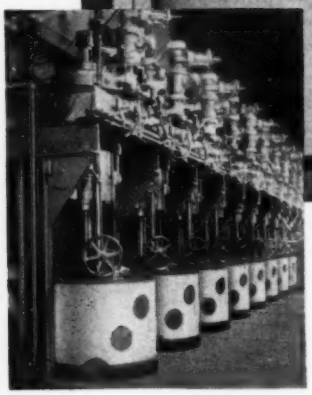

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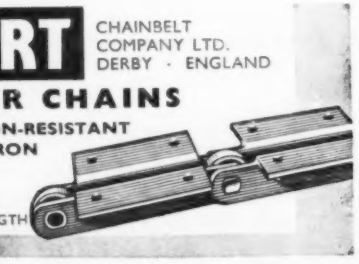

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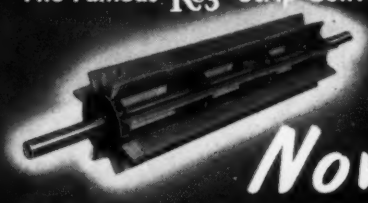

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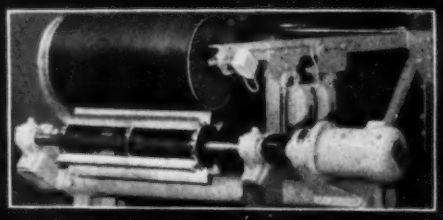

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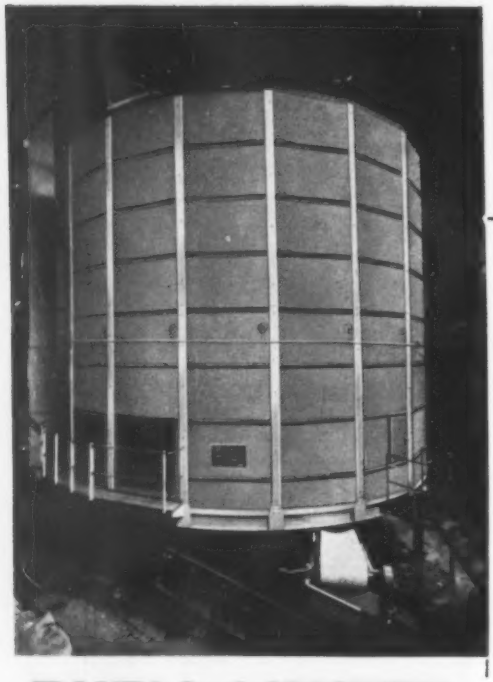

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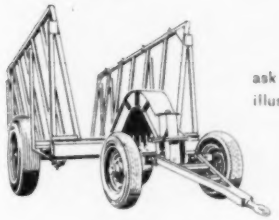

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|---|---|---|---|---|
| Plata, P. R. | 5000 | 15-25 | 34-42 | 90% |
| Coloso, P. R. | 6000 | 17-27 | 35-45 | 82% |
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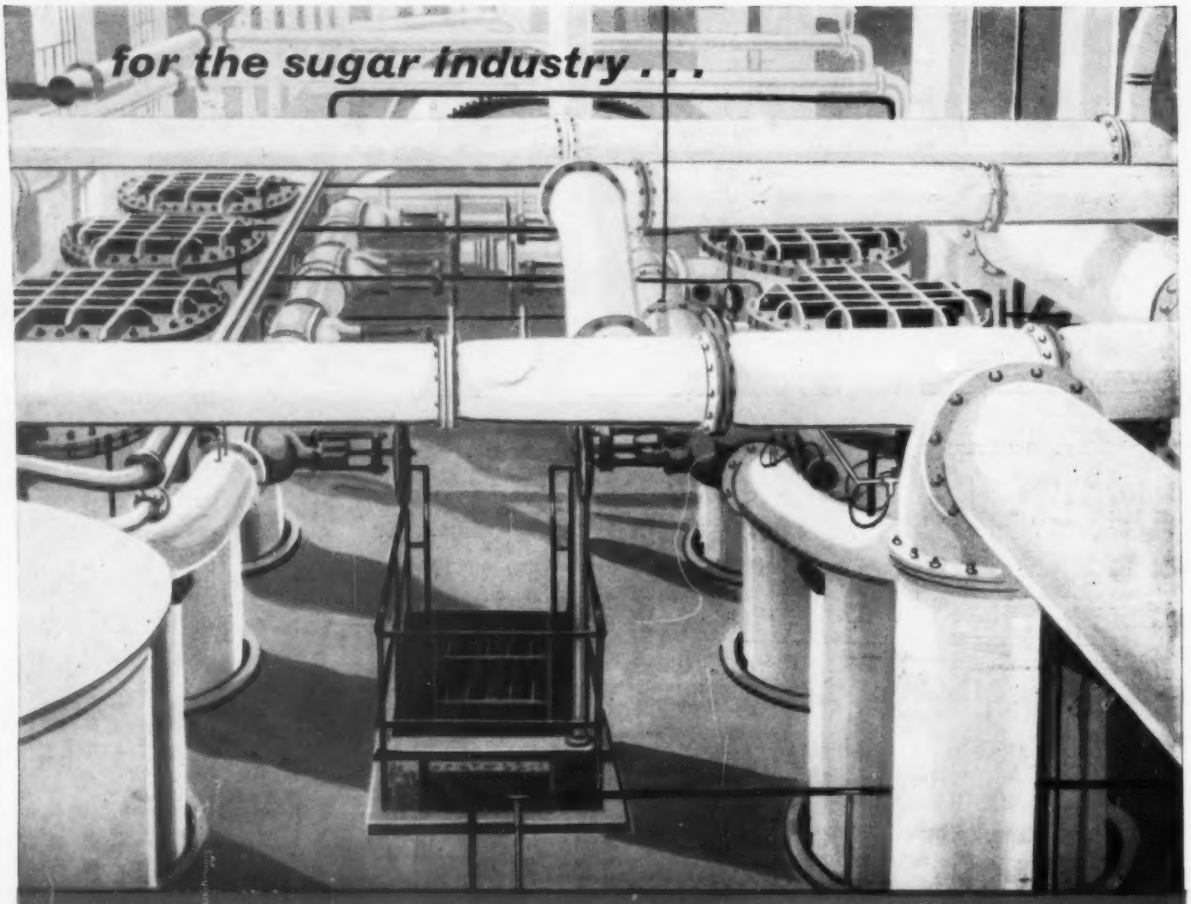

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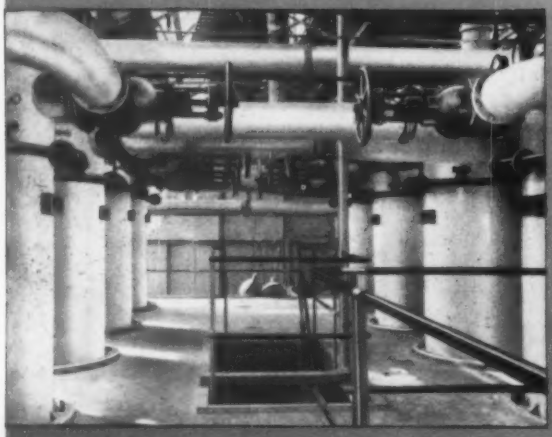

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